MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE. Assistant Editor: HERBERT C. HUNTER.

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The MONTHLY WEATHER REVIEW is based on data from about 3500 land stations and many ocean reports from vessels taking the international simultaneous observation at Greenwich noon.

Special acknowledgment is made of the data furnished by the kindness of cooperative observers, and by R. F. Stupart, Esq., Director of the Meteorological Service of the Dominion of Canada; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. I. S. Kimball, General Superintendent of the United States Life-Saving Service; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Director Meteorological Office, London; Maxwell Hall, Esq., Government Meteorologist, Kingston, Jamaica; Rev. L. Gangoiti, Director of the Meteorological Observatory of Belen College, Havana, Cuba.

As far as practicable the time of the seventy-fifth meridian is used in the text of the MONTHLY WEATHER REVIEW.

Barometric pressures, both at land stations and on ocean vessels, whether station pressures or sea-level pressures, are reduced, or assumed to be reduced, to standard gravity, as well as corrected for all instrumental peculiarities, so that they express pressure in the standard international system of measures, namely, by the height of an equivalent column of mercury at 32° Fahrenheit, under the standard force, i. e., apparent gravity at sea level and latitude 45°.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

IN GENERAL.

In November the great permanent winter area of high barometric pressure begins to build up over the interior of Asia. Barometric pressure also increases over the interior portions of Europe and North America. Over Bering and Greenland seas permanent winter areas of low pressure begin to form. In the tropical regions of the North Atlantic Ocean the weather is usually fine. In the Pacific Ocean area the typhoon season is nearing its end.

In the United States the Pacific coast wet season has fully set in. On the northeastern slope of the Rocky Mountains and in Arizona and New Mexico November is one of the driest months of the year. Killing frost is likely to occur in the Gulf and South Atlantic States, and light to heavy frost in northern portions of the Florida Peninsula.

In November, 1907, the Asiatic high barometer area began to build up rapidly during the second decade, and early in the third decade readings above 31.00 inches were reported in that region. During this period barometric pressure gradually diminished in the Iceland area to a reported minimum of 28.48 inches on the 22d. Pressure was generally low during this period over Bering Sea, and high over the Azores and Hawaiian Islands. This general distribution of pressure was attended by unsettled and unseasonably warm weather over the middle and northern latitudes of the North American Continent and western and northwestern Europe.

In the United States the first decade of the month was stormy. From the 1st to 3d a storm advanced with increasing intensity from the north Pacific to the north Atlantic coasts, attended by heavy rain generally over the eastern half of the country, and by gales on the Great Lakes and the Atlantic coast. Following this disturbance pressure continued low in the north and northwest, and on the 6th a barometric depression covered the country east of the Mississippi River, with a storm of marked strength central over Virginia. This storm deepened during the 6th and by the evening of that date had advanced to southern New England, where a barometric minimum of 28.90 inches was reported at Hartford, Conn. From the 1st to 4th severe storms were experienced over southwestern Europe.

The first half of the second decade of November was, on the whole, fair and cool in the United States. During this period a cool wave swept from the northeastern slope of the Rocky Mountains eastward and southeastward, carrying the line of zero temperature into northern Nebraska, and the line of freezing temperature to the interior of the Gulf and South Atlantic States. Light frost was reported in the interior of northern Florida. During the last half of the month a succession of barometric depressions advanced northeastward from the Gulf of Mexico, attended by frequent and at times heavy rain in the Gulf and Atlantic States, by snow in the Northeastern States, and by gales of greater or less severity along the Atlantic coast and over the Great Lakes.

The month closed with rapidly rising pressure over the British Isles-Iceland area and falling pressure over the interior of Asia and east-central Europe. In the United States the so-called permanent winter high area had formed over the Plateau region, and seasonably cool and generally fair weather had set in over interior-western districts.

BOSTON FORECAST DISTRICT.*

[New England.]

The weather of the month was generally characteristic of the season, with the precipitation above the normal over a large portion of the district, and temperature near the normal or above. Snow fell in parts of all the New England States, with the monthly amounts ranging from a trace to 14 inches, the latter amount being at Jacksonville, Vt. Severe gales prevailed along the coast on the 6th and the 24–25th. On the 6th the high winds did minor marine and local damage, and delayed more or less shipping of all classes. During the storm of the 24–25th shipping was completely tied up thruout the coast. Vessels in Boston Harbor dragged anchor and there were several narrow escapes from collisions. The tides were the highest in many years, and hundreds of cellars along the water front and in lowlands were flooded, and much damage resulted. Seaside cottages and other property suffered more or less damage from the gales and the high water. The Canadian schooner *Cora B* was driven ashore near Gloucester; damage, $20,000; crew saved. The schooner *Eastern Light* went ashore at High Cliff and was badly damaged; crew saved. The schooner *Lucy E* was wrecked near Duxbury; crew saved by the Gurnet Life Saving Station. According to newspaper accounts there was more or less damage to shipping along the entire New England coast.

Storm warnings were issued on the 2d, 6th, 20th, 21st, and 24th. There were no storms without warnings. The timely

warnings of the 6th and the 24th doubtless resulted in the saving of much property and many lives.—*J. W. Smith, District Forecaster.*

NEW ORLEANS FORECAST DISTRICT.*

[Louisiana, Texas, Oklahoma, and Arkansas.]

The rainfall was excessive and the temperature deficient. A severe cold wave, the first of the season, past over the district from the 10th to the 14th, when freezing temperatures occurred almost to the coast line. Timely warnings for frost and freezing temperatures were issued for the northern portion of the district on the 9th and for other portions on the 10th, 11th, 12th, and 13th. The warnings, which were widely distributed, enabled the protection of vegetation and the windrowing of sugar cane in exposed localities. Cold waves occurred in some sections without warnings, but the warnings for freezing temperature served all public interests in these localities. Frost warnings, which were partially verified, were issued for limited areas on four other dates. No general frost or freeze occurred without warnings. Storm warnings were issued on the 11th, 16th, and 19th, and brisk to high winds occurred during the display in each instance. No general storm occurred without warnings.—*I. M. Cline, District Forecaster.*

LOUISVILLE FORECAST DISTRICT.*

[Kentucky and Tennessee.]

During the month seasonable conditions largely prevailed for the district as a whole. In Kentucky the temperature and precipitation were both somewhat below normal, but in Tennessee these elements averaged nearly normal, except in the northeastern portion, where the rainfall was nearly double the average November amount. Clear skies largely predominated, being in decided contrast to last year.

There were six marked disturbances during the month. Two of these, the 1st–2d and the 30th, moved in from the northwest, while the other four—17–18th, 19–20th, 22d–24th, and 28th—were from the southwest, or west Gulf section. The storm of the 19–20th, which moved from Texas up the Mississippi Valley to the Lakes, was the most severe, being attended by heavy rains and high winds.

There were no cold waves, and no special warnings were issued, altho advice of decidedly colder weather was sent out the morning of the 10th.—*F. J. Walz, District Forecaster.*

CHICAGO FORECAST DISTRICT.*

[Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas, and Montana.]

The month was characterized by a marked deficiency in precipitation and an unusual amount of sunshine over the entire district; the temperature was above the normal, except in the extreme eastern portions.

No cold waves occurred during the month, and there was no considerable fall of snow, except on the 30th, when a fall of several inches occurred in the western Lake region. Special snow warnings were issued for southern lower Michigan and northern Illinois.

The month was unusually free from severe windstorms on the Great Lakes. Warnings were issued on eight dates in advance of storms of moderate energy, and no casualties were reported.—*H. J. Cox, Professor and District Forecaster.*

DENVER FORECAST DISTRICT.*

[Wyoming, Colorado, Utah, New Mexico, and Arizona.]

The month was cool and generally dry. There were comparatively few marked changes in temperature. Rain or snow fell on but few days, and was generally below the normal amount.

No special warnings were issued. Moderate cold waves, without warnings, occurred as follows: Northeastern Colorado, on the 10th; central Wyoming, on the 19th; and northwestern Wyoming, on the 27th. These cold waves were not marked by unusually low temperatures.—*P. McDonough, Local Forecaster, temporarily in charge.*

SAN FRANCISCO FORECAST DISTRICT.†

[California and Nevada.]

This was the driest November recorded at this station during a period of fifty-nine years, excepting only November, 1890, which was without any rain over a large portion of the State. At San Francisco there were but three rainy days, the total amount being .04 inch. The normal amount at San Francisco in November, based upon a fifty-nine years record, is 2.64 inches, so that the deficiency during the current month is very marked. The chief cause was the presence of a persistent high area over the Rocky Mountain section, the basin ranges, and the Pacific slope. This has caused northerly winds thruout California and a large portion of Nevada, with cool mornings and high afternoon temperatures.

A number of frost warnings were issued during the month, but there were no injurious frosts, and no special warnings were necessary.—*A. G. McAdie, Professor and District Forecaster.*

PORTLAND, OREG., FORECAST DISTRICT.†

[Oregon, Washington, and Idaho.]

The month was uniformly mild, and the rainfall was somewhat less than normal. The center of a severe disturbance past over the northern boundary of the district on the 1st. This was followed by a long period without storms that lasted until the 19th, when disturbances again began crossing the North Pacific States, and continued with great frequency nearly up to the close of the month. Eight warnings for storms were issued, and with hardly an exception they were fully verified. The most severe storm occurred on the 25th, at which time maximum velocities of slightly over 70 miles an hour occurred at the coast stations, and the unusually high velocity of 51 miles was reported at Seattle, Wash. Notwithstanding the long period of stormy weather no noteworthy marine casualties occurred, and this of itself bespeaks the value of the warnings.—*E. A. Beals, District Forecaster.*

RIVERS AND FLOODS.

The stages of the rivers of the Mississippi system did not depart greatly from their usual averages for the time of the year. There was a fair rise in the Ohio River about the middle of the month. It past into the Mississippi on the 20th and reached the Gulf of Mexico about December 3.

The rains of the 6th and 7th caused a general rise in the rivers of southern New England and the Middle States, but not to within several feet of the flood stages, except in the lower Connecticut and Hudson rivers. Both of these rivers had been quite high as a result of frequent rains over the upper watersheds, so that the heavy rains of the 6th and 7th were certain to result in some high water. Warnings for the lower Connecticut were issued on the 7th, and on the morning of the 8th the stage of the river at Hartford was 19.7 feet, 3.7 feet above the flood stage. The crest stage of 20.3 feet was reached on the morning of the 9th, after which the decline set in. The damage and losses were trifling, as the water had not had an opportunity to recede greatly from the high stage of October 31.

Warnings were issued on the 7th for flood stages in the Hudson River in the vicinity of Albany. The flood stage of 12 feet at Albany was past during the night of the 7th, and by the morning of the 9th the water stood at 13.9 feet, 1.9 feet above the flood stage, and practically the exact stage that had been forecast. At Troy, N. Y., the crest stage was 18 feet, 4 feet above the flood stage.

Advisory warnings were issued on the 22d and 23d for a moderate rise in the Alabama River, and on the 23d for a similar condition in the Oconee and Ocmulgee rivers of Georgia. Warnings were also issued at the proper time for the flood that occurred in the Wateree River of South Carolina on the 24th and 25th, and for the flood stage in the lower Roanoke River on the 26th.

The heavy rains that fell over eastern Texas from the 15th to the 20th, inclusive, were followed by moderate floods in the rivers of that district, except in the Neches, and the upper portions of the Brazos and Colorado rivers. Flood stages were exceeded, but not to any decided extent, except in the valley of the Guadalupe and lower Colorado rivers, where the rains had been heavier, resulting in stages from 7 to 10 feet above the flood stages. Warnings were issued regularly from the 18th until the 20th, inclusive, and no reports of damage or loss have been received. The rivers of the Pacific States were quiet.

The highest and lowest water, mean stage, and monthly range at 197 river stations are given in Table VI. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor of Meteorology.*

* Morning forecasts made at district center; night forecasts made at Washington, D. C.

† Morning and night forecasts made at district center.

SPECIAL ARTICLES, NOTES, AND EXTRACTS.

PHENOMENA CONNECTED WITH THE SAN FRANCISCO EARTHQUAKE.

By Dr. C. M. Richter and Prof. Alexander G. McAdie. Dated San Francisco, Cal., December 28, 1907.

A number of phenomena have been reported in different publications (Science, Nature, Gaea, and others), as observed during and after the earthquake of April 18, 1906, which it seems to us need more accurate description and a statement of the facts as we know them, who were present at the time and made notes of them.

First, we may call attention to earthquake sounds. Such sounds were reported by many people after the earthquake. Many claim to have heard a sound comparable to an approaching windstorm or the roll of a heavy wagon; but in our judgment most of these sounds can be explained by the noise due to violent shaking of dwellings. There are, however, some reports of a sound like that of a violent wind preceding the first shake. We have no record of any detonation coming from the ground.

With regard to light and fire phenomena a number of statements have been made, many of which have been shown to be erroneous by "D. S. J." in Science.[1] Some of the most elaborate and detailed statements of such phenomena were given by those who were not in San Francisco during the earthquake.

We have no proof whatever that any particular optical or electrical phenomenon occurred preceding, during, or following the earthquake. The atmospheric conditions preceding and at the time of the earthquake are described in the report of the California section of the Climatological Service of the Weather Bureau for April, 1906. This report states:

> The morning of Wednesday, April 18, was clear and pleasant over the greater portion of the Pacific coast. An area of high pressure was moving steadily and somewhat slowly eastward over Idaho. The weather map gives the conditions existing a few minutes previous to the great earthquake, and it may be noted that the pressure distribution is of a type that has been found to prevail when certain earthquakes occur in California. A study of the relation of atmospheric pressure and earth movement had been under way in the office of the Weather Bureau at San Francisco for some years, and while no very definite conclusions had been arrived at it was plain that the greater number of earthquakes in California occurred apparently without any relation to pressure distribution. It was noticed, however, that some earthquakes occurred during the passage of a marked high across the northern portion of the coast. While any relation of this character must be obscure and indefinite, it is conceivable that in a region where quakes and tremors of tectonic origin are frequent—i. e., a region where strata are in unstable equilibrium—the passage of an area of high pressure may directly or indirectly affect the stresses at critical times. The relation is involved and is alluded to here only because at Manila and Tokyo microseismic phenomena bear some relation to approaching typhoons. The thought suggests itself that the installation of seismographs on the Pacific coast may lead to the detection of advancing pressure areas.

A. Sieberg[2] asserts that "die Erdbeben die örtliche witterung nicht beeinflussen", and later[3] "Die Luftdruckschwankungen vermögen den Eintritt von Dislokationsbeben zu fördern". His material would rather favor a falling barometer as a causative factor. At the time of the San Francisco earthquake there was a well-defined high over practically the entire area of the United States. Similar barometric conditions had occurred at the beginning of April and at other times. The high of April 18 had no unusual characteristics.

Much has been said by various reporters about the high winds and marked indrafts of air due to the fire. It has been said that the strong winds caused by the fire were felt miles at sea. Concerning this, the best comment that can be made is that the instruments of the Weather Bureau were in place thruout the entire day of April 18. The Weather Bureau records are continuous up to 5 p. m. of the 18th, or, in other words, for a period extending thru the earthquake and twelve hours after the earthquake. These records are available, and show that there were no unusual features connected with air motion. The wind had been westerly on April 17, with a velocity of 14 miles an hour, the sky clear and the weather pleasant. A few minutes preceding the earthquake the wind was from the west, velocity 3 miles per hour, weather clear. At 5 p. m. of the 18th the pressure, reduced to sea level, was 30.15 inches; the temperature of the dry-bulb thermometer, 61.8° F., of the wet-bulb thermometer, 54.0°; and the direction of the wind, west, the velocity, 22 miles an hour. In brief, then, there was nothing remarkable in a meteorological way during the twenty-four hours under consideration. It was a pleasant spring day.

Some reports have been published concerning unusual clouds formed early during the fire and described as caused by the fire. One of the writers of this article photographed the smoke cloud as early as 8 a. m., that is to say, less than three hours after the beginning of the fire. These clouds were also carefully observed by observers of the Weather Bureau. They were, so far as we could determine, purely smoke masses, and the general elevation of the top of these clouds was probably not above 500 feet. Certain peculiarities have been reported concerning these clouds.[4] Except for their size and density, we who closely observed these appearances at the beginning and during the whole period of the fire remember seeing nothing that can not be explained as smoke effects, such as a large fire would cause. While the appearance of the smoke at different hours was interesting, there was no unusual or phenomenal cloud development. So far as we could determine, there was no marked indraft of air caused by the intense heat. The lower air movement agreed with the usual movement due to the passage of an area of high pressure, the light north and northeast winds giving way to moderately strong west winds. It was apparently this change that prevented the complete destruction of San Francisco by fire.

There was no tidal wave or unusual disturbance in the Bay of San Francisco. As a matter of fact, the waters of San Francisco Bay were unusually calm on April 18, before, during and after the earthquake. In this connection it might not be

[1] Issue of August 10, 1906.

[2] Handbuch der Erdbebenkunde, 1904, p. 124.

[3] Ibid., p. 126.

[4] See Science, November 14, 1906; Nature, vol. 74, 1906, p. 133; also Science, April 5, 1907, p. 554.

out of place to note that Prof. George Davidson has corrected a statement published in the description of the earthquake at San Francisco on February 18, 1856, where one writer states that "the water in the Bay of San Francisco rose, maintained its level for five minutes, and then sank 2 feet below its ordinary stage". Professor Davidson obtained a tracing of the mareograph from the Coast Survey, and this shows that the trace of the water level was remarkably smooth on the date in question.

Presentiments of the earthquake have been reported by reliable witnesses. Many people have stated that they past a restless night preceding the earthquake and were awake some hours before the earthquake occurred. Reports were also made of unusual manifestations made by animals. Our explanation of such conditions is that sleeplessness or unusual manifestations of the nervous system are not infrequent in California during the passage of a well-marked area of high pressure accompanied by low relative humidity and northerly winds.

Incidentally we may mention that the Weather Bureau records were faithfully and regularly made on April 18, the day of the earthquake. The great shock was at 5:13 a. m., and the Weather Bureau records are complete up to 5 p. m. of that day. The building caught fire on the evening of April 18. We lost three observations during the three days' fire, namely, a. m. of the 19th, p. m. of the 19th, and a. m. of the 20th. Our records begin again about noon of the 20th, while the fire was still raging.

THE CHRISTMAS SNOWSTORM OF 1906.

BY HUGH ROBERT MILL, Director of the British Rainfall Organization, 62 Camden Square, London, NW.

[Reprinted from British Rainfall, 1906.]

By Christmas eve 3,521 circulars containing forms for recording the rainfall of 1907 had been prepared for posting, tied up in bundles of 60 each, and left ready at 62 Camden Square, to be sent to the post-office on the appointed day. The assistants had left for their short and well-earned holiday, and there seemed to be a week of comparative leisure before us. On the morning of Boxing Day (1906) the whole neighborhood of London was found covered with 4 or 5 inches of snow, which had come down in the night, and at Mill Hill the circumstances were so interesting that we resolved to make a special and detailed investigation into the storm, if so soft and silent an envelopment could be called by such a name. The night of the 25th had been fine and star-lit, with white clouds appearing about 10 p. m. in the southwest, and at 11 p. m. no snow or rain was falling. Next morning, at 7 o'clock, the sky was blue and clear, the wind blowing cold as a light breeze from the northeast, and grass and trees were covered alike with a snowy fleece. There had evidently been a fierce wind in the night, for the snow was drifted deeply against walls and hedges, and plastered thickly on the southwestern sides of trees and walls; the northeastern sides were entirely clear, showing that there had been a shift of the wind to a diametrically opposite quarter since the drifting ceased.

Next morning the newspaper reports showed that the snowfall had been very widespread, and we sent the accompanying form[1] to the printer, in order to give all rainfall observers an opportunity of recording their experiences. By the evening the first batch of copies was received. It took the evening of the 27th and nearly all day on the 28th to get the 3,000 ungummed envelopes loosened from their bundles, opened, the slips inserted, and the envelope flaps tucked in and made up again in bundles of 60. The 521 packets in closed envelopes for those observers who report monthly could not be dealt with in this way, so snow circulars for that number had to be separately addressed; but at length they were completed and dispatched just before the closing time of the post-office on the 28th.

The number of slips which returned to us with information was 1,862, and we must regretfully acknowledge that we have not been able to do more than touch upon some salient lines of the information they contained. All are preserved, and we hope they can be further utilized. The storm was not the isolated phenomenon which the first newspaper reports had led us to expect. It was followed for several days by snowy conditions, and it was soon apparent that during the last week of the year there were two separate snowstorms, one on the 25th and 26th, which affected the west of Scotland and the whole of England, except the northeast, gently and with little inconvenience; and another on the 27th and 28th, which was very severe indeed in the east of Scotland, in Ireland, and the southwest of England. In parts of Yorkshire and the border counties both storms appeared, and in some of these places it is difficult to distinguish between them. The second storm was accompanied by strong electrical disturbances and a severe gale, so that the light, powdery snow was driven into enormous drifts, causing much distress to farm and village dwellers in Aberdeenshire and adjacent counties. Aberdeen itself was cut off for several days from telegraphic and railway communication with the rest of the country. A terrible railway accident occurred in the thick of the storm at Elliott Junction, near Arbroath, causing loss of life, and the storm was in every way one of the severest on record.

After a cursory examination of the returns, and the elimination of those the statements on which were too vague to be useful, we decided to deal only with the first storm, and to limit our work to a consideration of the depth of snow over the country and the hour at which the snowfall commenced. This storm was by no means the severest, and perhaps not the most widespread, in recent years; but the great quantity of data obtained from skilled observers makes it possible to deal with it more exactly than has ever been practicable before.

We have made many maps of heavy falls of rain, but it is a very difficult thing to map a light fall, on account of the uncertainty as to the date of entry by observers who do not consistently follow the rule. In the case of a heavy fall, the individuality of the day is so well marked that those who enter to "wrong day" are immediately detected. A fall of snow is much more conspicuous than a shower of rain, and estimates of the depth of snow, though individually less accurate than measurements of the fall of rain, may collectively give a good general account of what is equivalent to a light shower; hence one part of the value of studying snowfall.

Care was taken first to eliminate those returns which lumped together the snowfall of several days, and all the figures which belonged to the period 25–26th were plotted on a map on the scale of about 20 miles to an inch. The error in measuring snow may lead to over or under estimates, for drifting increases the depth in some places and diminishes it in others; hence it is to be expected that large figures will sometimes be found amongst a group of small values, and that a few small figures will be found in the midst of an overwhelming crowd of larger. But when, as in this case, the figures are very numerous it is easy to see and to ignore the minority of dissentient values, be they too high or too low, and we found it possible by following the majority to prepare a very serviceable map of the depth of snow on the day in question. This map we reproduce on a reduced scale (fig. 1). It shows in solid black those parts of the country where no snow fell; but there was precipitation on that day in the form of rain over the western areas at least, where the temperature did not admit of the formation of snow. The area of the snowfall is seen to be a zone (150 miles broad in the north and widening to 200 miles in the south) stretching from northwest to southeast from the north of Ireland and west of Scotland to the English Channel

[1] Omitted in this reprint.—EDITOR.

and North Sea. The zone is parallel to the track of a secondary depression which crossed the British Isles on the 25th and 26th from the North Channel between Ireland and Scotland to the mouth of the Thames, the center being at the former point at 6 p. m. of the 25th, and at the latter at 8 a. m. of the 26th. The snowfall was heaviest on the left of the track, and although the distribution shows some irregularities which may be due in part to the uncertainty of the estimates of depth, it is plain that the heaviest fall occurred in a central belt (left white on the map) running from Manchester and Leeds to Lincoln and Ipswich. Here for a length of 200 miles and a mean breadth of 40 miles the depth of the snow everywhere exceeded 8 inches, while over nearly the whole of Norfolk and Suffolk the depth exceeded 10 inches, and in the center of these counties, over nearly 1,000 square miles, the snow lay to the depth of a foot. It appears to be possible that the snow of the storm which brought such heavy falls to the east coast on the 27–28th may have begun in Norfolk before the snow of the 25–26th stopped, and that this may account for the great depth recorded there. From the axis of maximum snowfall the depth fell off very quickly to the northeast, and extremely gradually to the southwest. It is interesting to note that the area of snowfall under 2 inches is greatest in the valleys of the lower Severn and Warwickshire Avon.

Fig. 1.—Map of British Isles, showing depth of snowfall of the Christmas snowstorm, 1906. Black areas indicate no snow (but possibly rain); shaded and white areas indicate snowfall, the darkest shading signifying the least depth.

In order to assist us in correcting the ordinary rainfall returns for snow which was improperly excluded, we prepared a rough map of the total depth of snow for the last week of the year. This map showed three distinct centers of maximum snowfall in the northeast of Scotland, in East Anglia and in the north of Ireland. It showed an absence of snow around the Bristol Channel, and a curiously isolated area in the center of the Lowland Plain of Scotland between the firths of Forth and Clyde, where there was extremely little. That area, in fact, escaped the two great storms, while all round it the country had been visited by one or both.

Fig. 2.—Map of isochronic lines, showing time of beginning of snowfall, December 25–26, 1906. Black areas indicate no snow.

Maps of exceptional snowfalls have been made before, and a good example will be found in Symons's Meteorological Magazine for February, 1881 (Vol. 16, frontispiece); but, so far as we are aware, the rate of movement across the country of the beginning of a snowstorm has not been previously mapped with anything like the detail which has been found possible in the present case. The movement of a line-squall across the country has been traced on several occasions from a comparatively small number of observations, the correctness of which was guaranteed in most cases by barograph traces; but here we have had a very large number of observations widely scattered over the whole country. The time of the commencement of the storm was noticed the more carefully because it happened to be on Christmas day or Christmas night, but the exact moment at which the snow commenced could not be given in most cases. A number of observers in those parts of the country where the storm began at night were able to say positively that no snow fell before a certain hour, and a large number had taken the trouble to inquire from policemen, night-watchmen, and others whose duties afford opportunities of noting the commencement of the snow. When all the figures we received had been

charted the hour of commencement was found to be very distinctly later as one proceeded from west to east, and, although the figures were often contradictory, it was possible to draw lines that represent what may be called the prevailing hour of commencement. These lines are drawn in a somewhat generalized form, and it is possible that there should be more anomalous hours of commencement than those which are shown in the two small areas, one in Monmouthshire, the other west of Cambridge; but these were the only places where the weight of evidence seemed to us to demand exceptional treatment. (See fig. 2.)

Speaking generally, the isochronic lines ran from north to south, with a slight tendency to diverge southward; but it may be that they would be better viewed as concentric curves, perhaps portions of circles, the common center of which lay somewhere near the northwest of Ireland. The facts, as shown by the isochronic map, are that the snowstorm began in the north of Ireland shortly before noon of Christmas Day, or about six hours before the center of the depression arrived there, and that the storm began later and later toward the east and south, until it was after 2 a. m. on the 26th before it commenced at the mouth of the Thames, i. e., six hours before the center of the depression arrived there.

It thus appears probable that snow began in the front of the approaching cyclone about six hours in advance of the passing of the trough, and it appears likely that the snowfall lasted until immediately after the trough passed; but the hours given for the cessation of the snow are less precise than those for its commencement. At Camden Square the barograph showed that the trough passed about 6 a. m., after which the barometer began to rise, and the snow ceased about the same time.

The map shows that at noon on Christmas Day snow was beginning on the northeast of Ireland; at 2 p. m. it was snowing along a line from Islay and Kintyre to Larne; at 4 p. m. the snow reached Mull, Galloway, and almost the Isle of Man; at 6 p. m. it almost reached Skye, Glasgow, Dumfries and the coast of Lancashire; at 8 p. m. it was snowing from Skye to Manchester and thence to Cardiff and Bridgwater; at 10 p. m. the line of the commencing storm ran from the Tyne through Leeds, Sheffield, Derby and Birmingham, to near Bournemouth; by midnight it stretched from Goole to Brighton, and, sweeping over London, by 2 a. m. on the 26th, it ran from Hull through Lincoln and Cambridge to Dover. An hour later the storm had passed out into the North Sea, and the whole country was painted white from the Isle of Skye to the Isle of Thanet.

The rate of advance of the front of the storm measured by the commencement of precipitation was least rapid in the north, where it was $12\frac{1}{2}$ miles an hour, and most rapid in the south, where it was about 19 miles an hour, but the rate varied a little from point to point. The interesting fact is, however, that a motor car could have kept out of the storm by traveling, without exceeding the legal speed limit, in the direction of its progress. At 8 o'clock on Christmas night snow was beginning to fall simultaneously along a line of 500 miles, this being the longest snow-yielding portion of the storm front at any time.

WELL-MARKED FOEHN EFFECTS WITH GREAT DIURNAL RANGES OF TEMPERATURE IN SOUTHERN CALIFORNIA.

By Prof. A. G. McAdie. Dated San Francisco, Cal., December 2, 1907.

Some unusual ranges of temperature were recorded in California at the close of November, 1907. A well-marked foehn effect was noticeable in southern California November 29 and 30, and December 1. Maximum temperatures of 86° occurred at Los Angeles and at San Diego on the afternoon of November 29. On the 30th, maximum temperatures of 84° occurred at Los Angeles and at San Luis Obispo, and 80° at San Diego. On December 1 maximum temperatures ranged from 80° to 85° thruout most of California.

The morning temperatures thruout this section were generally low, and at many places frost was reported in the morning. For example, at San Luis Obispo frost occurred on the morning of December 1, with a minimum temperature of 38°, which was also the temperature at the time of the observation—4:45 a. m. The temperature at the time of the regular observation preceding the frost was as high as 86°, and on the afternoon following as high as 84°. We therefore have a range of about 50°; or, allowing 32° for the frost temperature, a cooling of 54° between 3 p. m. and 5 a. m., or about 14 hours. In my experience as forecaster on this coast I do not recall such a temperature amplitude. The frost deposit was probably not heavy; but we must assume that the temperature would have been still lower but for the latent heat of condensation of vapor to water and water to ice.

The illustration is valuable, we think, in connection with the theory of the nocturnal cooling of the ground and atmosphere.[1] The observation may be of value in connection with the determination of the coefficient of radiation of air. It may be assumed that the air was clean, free from dust and water vapor; altho a puzzling condition is that San Luis Obispo is only about 10 miles from the coast. The elevation of the thermometer is about 47 feet above the ground, and the elevation above sea level is about 200 feet. It would seem that under the conditions given, the heat waves—long wave lengths—past thru the air within 40 feet of the ground, with comparatively little absorption. The fall in temperature would seem to be a pure radiation effect and the illustration shows how very important radiation is in frost formation.

THE CENTRAL PENNSYLVANIA METEOR OF OCTOBER 1, 1907.

By Prof. Henry A. Peck. Dated Syracuse University, Syracuse, N. Y., December 13, 1907.

The evening of October 1, 1907, Mr. Clayton B. Chappell and Mr. T. H. Parkhurst, seniors in the Syracuse University, reported that they had seen a remarkable meteor about 6:30 p. m. A few days afterwards some newspaper clippings arrived, showing that it had been observed over a range of territory that extended from Toronto to New York City. Meanwhile there had appeared in New Jersey and Pennsylvania another meteor of the largest size, which had attracted universal attention over a wide area. The Central Office of the Weather Bureau made a very thoro postal-card canvass of this region, the report of which will appear in a later number of the Monthly Weather Review. Among the answers were many that evidently referred to the earlier meteor, and it is largely with these as a basis that the following has been written.

Aside from the regular staff of observers of the Weather Bureau, the following have kindly furnished information:

New York.

Charles P. Arnold, Angelica.	O. H. Hauber, Ithaca.
P. J. Flanagan, Brooklyn.	Kenneth Baker, Jamestown.
Felix C. Moore, Buffalo.	W. H. Knapp, Jamestown.
Mrs. Wallace W. Jacques, Chazy.	Charles A. Hoag, Lockport.
C. E. Robinson, Clay.	Mrs. Eugene Buttrick, Lockport.
Mrs. G. O. Barnes, Cortland.	M. D. Clinton, Newark Valley.
Harold Henry, Dannemora.	William P. Ray, Olean.
F. J. Hill, Dryden.	Mrs. A. W. Ferrin, Preble.
Frank Fayent, Fort Plain.	S. C. Williams, Rochester.
Mrs. Nellie Sherman, Greenwood.	C. B. Chappell, Syracuse.
E. L. W. Smithers, Hammond.	T. H. Parkhurst, Syracuse.

New Jersey.

Samuel K. Pearson, jr., Jersey City.

[1] See S. Tetsu Tamura, Monthly Weather Review, April, 1905, vol. xxxiii, p. 138-140.

Pennsylvania.

Welcome Richmond, Dixon City.	Mrs. Malvin Edwards, Moscow.
Ignatz Gutknecht, Dixon City.	M. E. Hathaway, Scranton.
Frank T. Swartz, Dunmore.	Henry J. Hart, Scranton.
M. L. Heisler, Harrisburg.	Mary Parsons, Scranton.
U. N. Steickler, Hummelstown.'	Howard J. Kline, Shamokin.
Rev. J. M. Welch, Indiana.	

Virginia.

E. T. Waddill, Roxbury.

Contrary to general experience, the point of first appearance of this meteor seems to be better determined than any other point of its course. Accordingly this point was first located by the method of intersecting azimuth planes from the following observations:

Number.	Place.	Position of station. Longitude.		Latitude.		Azimuth.
		°	′	°	′	°
1	Jersey City, N. J	74	2	40	45	n. 65 w.
2	Orville, N. Y	76	2	43	1	s. 30 w.
3	Dryden, N. Y	76	18	42	29	s. 30 w.
4	Shamokin, Pa	76	34	40	47	n.
5	Halifax, Pa	76	54	40	26	n.
6	Lockport, N. Y	78	40	43	11	s. 50 e.
7	Indiana, Pa	79	10	40	40	n. 45 e.

The point whose geographical coordinates are longitude 76° 52′ west, latitude 41° 56′ north, almost exactly satisfies these azimuths, the residuals in the equations nowhere exceeding the third place of decimals. A reference to a map shows this point to be south of Elmira, N. Y., just across the State boundary line and near Dunning, Pa.

Not all the observers estimated the angular altitude above the horizon. The individual results for the elevation at which the meteor first became visible are:

Jersey City	99 miles.
Orville	71 miles.
Dryden	50 miles.
Buffalo	98 miles.
Fort Plain	91 miles.
Average	82 miles.

The Dryden estimate is so lacking in harmony with the remainder that it has been eliminated, and thruout the computation it is assumed that the meteoric mass began to glow at a distance of 90 miles above the surface.

The observations of the end point are singularly deficient in altitudes and consist almost wholly of azimuth estimates. Together with this deficiency there is also a lack of definite data upon which to found a solution by the Galle method. The method that has been followed to find the radiant point is one for which the author is responsible, and, if lacking in the quality of mathematical elegance, it is quite practical when applied to observations of this character. The various azimuths and directions in which the flight had been observed were plotted upon a map. The result showed that many of these estimates were contradictory and indicated great confusion on the part of the observers. However, there are five of the estimates that lead to a very marked intersection, and the hints received from newspaper clippings originating in the adjacent territory show that it can not be far from the true point. These observations are:

Station number.	Place.	Position of station. Longitude.		Latitude.		Azimuth.
		°	′	°	′	°
1	Moscow, Pa	75	33	41	17	s. 45 w.
2	Hazleton, Pa	75	59	40	59	s. 45 w.
3	Dryden, N. Y	76	18	42	29	s. 15 w.
4	Roxbury, Va	77	5	37	26	n.
5	Buffalo, N. Y	78	51	42	52	s. 23 e.

From these we deduce that the end of visibility took place in the zenith of the point whose geographical coordinates are, longitude 77° 10′ west, latitude 40° 5′ north.

Assuming the earth to be a sphere and the radius of the sphere to be the radius of curvature for the middle of the arc, the distance between the points in whose zeniths the beginning and end took place is 132 miles, and the azimuth of the point of beginning as seen from the point of ending is N. 6° 46′ E.

As stated before, the notices received are very deficient in statements of the altitude at which the meteor was last seen. This was probably due to the fact that to most of the observers it seemed to pass below the sensible horizon. A Buffalo observer thought it was extinguished at 20° altitude, but this is certainly an error. Observers at Toronto, Syracuse, and Rochester reported that it past below the sensible horizon. This would mean a probable altitude of not greater than five miles. There is another indication that it was comparatively close to the surface when extinguished. From various places in Pennsylvania near the end of the track it was reported as a detonating meteor. The great noise was heard at Halifax, Pa., about two minutes after the meteor past. This indicates a height of about 22 miles above the surface of the earth at the time of nearest approach to the observer. If the path of the meteor be drawn thru this point and the place of beginning of the flight, it will intersect the earth's surface so near the place whose latitude and longitude are given above as to be within the radius of probable error. In the remaining computations it has been assumed that the altitude at time of extinguishment was not more than five miles above the surface.

At several stations far apart the remark was made that the appearance of the meteor suggested that of an ordinary paper fire balloon. From the comparisons made with the apparent size of the moon the mass must have had a diameter of about 500 yards. When more than halfway in its course, at an altitude of not less than 30 miles, it separated into four or five bodies connected by a ribbon of light. These separate bodies continued to follow one another in the same apparent path. This would seem to show that the mass was a somewhat diffused aggregation of particles that became disintegrated, and that the particles grouped themselves according to the resistance they experienced in passing thru the atmosphere.

In order to find the elements in space it becomes necessary to find the length of the flight. Assuming that the elevation at the end of visibility was not more than 5 miles, the length of the path was 160 miles, and the altitude of the beginning as seen from the end was about 31°. Several observers give plausible estimates of the time of visible flight. These estimates average five seconds, and thus the velocity thru the atmosphere was 32 miles per second. The true radiant, free from the attraction of the earth and the effect of its motion in space, is, celestial longitude 345° 32′, celestial latitude 80° 8′.

The meteor was traveling in a path that was almost perpendicular to that of the earth, the angle between the two directions being 94°. The velocity in space before it began to feel the attraction of the earth was 27 miles per second. This is so near the parabolic limit that I have contented myself with finding a parabola that satisfies the observed direction and velocity, with the following result:

Longitude of ascending node	= 187.6°
Inclination of plane of orbit	= 86.3°
Longitude of perihelion	= 25.9°
Logarithm of perihelion distance	= 9.989

ADDENDUM.

Since the above computation was finished I have received a report of observations from Mrs. Levi Mullian, of Hartstown, in extreme western Pennsylvania, which confirms the position of the end point as above deduced, both in azimuth and alti-

tude, and which, therefore, if it had been used in the computation would not have altered the result.

I have also received a report of observations made by Mr. George F. von Ostermann and Mr. H. G. McKim, at Spalding, Prince George County, Md., which harmonizes with the orbit as given above.

THE RELATION OF THE MOVEMENTS OF THE HIGH CLOUDS TO CYCLONES IN THE WEST INDIES.

By JOHN T. QUIN. Dated St. Croix, Danish West Indies, October 30, 1907.

The following is offered in continuation of the article by the present writer, which was published under the above title in the MONTHLY WEATHER REVIEW for May, 1907.[1]

In that article it was shown that Father Viñes's theory, that, at the cirrus cloud level, the current from the vortex of a cyclone spreads out in "a completely divergent radial direction", holds good only at comparatively short distances (say between 100 and 200 miles); but that when the distance is greater the outflowing current, as shown by cirrus clouds, appears to come toward the observer from a point more and more removed to the right as the distance increases. In other words, the vortex, when at a great distance, is situated not in the direction of the radiating point of the high clouds, but in a direction to the left of that point, the amount of the divergence depending on the distance of the vortex from the observer.

It seems advisable to make a few remarks as a sort of supplement to the above-mentioned article, by way of clearing up some points that were then left in a somewhat uncertain position.

(1) In the description of the movements of the high clouds over St. Croix during the passage of the Cuban cyclone of October 17, 1906 (page 218), it is stated that, "On the 19th they were moving from the north; on the 20th at 7 a. m. from north-northeast; *on the same day at 5 p. m. again from north;* and on the 21st from east-northeast".

The part of the above statement which is now put in italics is so put to call attention to the remarkable fact that the radiating point of the high clouds, after having continued its forward movement from north as far round as north-northeast, then fell back again to north. This was left without comment in the article, but was regarded by the writer as a very weak point in the evidence, since it seemed from this irregular motion that these high clouds were not under a fixt law, but were governed by a kind of waywardness in their movements. So far, however, from being a weak point, it turned out, as will presently appear, to be one of the strongest that could possibly present itself. This was discovered when the writer, desiring to find out whether this hurricane, on leaving Florida, went forward over the Atlantic, as the movements of the high clouds here seemed to indicate, or whether it went off to the northwest, as stated in a telegram received here, lookt up the MONTHLY WEATHER REVIEW for October, 1906, and found there (page 479), in regard to this great storm, the following:

On the morning of the 17th, reports indicated the presence south of western Cuba of a well-defined cyclonic disturbance, and at 11 a. m. of that date storm warnings were ordered on the east Gulf, Florida, and south Atlantic coasts, and the following was telegraphed to Atlantic and Gulf ports, and to Havana, Cuba: "* * * Disturbance apparently approaching western Cuba from the Caribbean Sea. Unsafe for vessels next few days off western Cuba, Florida, and south Atlantic coasts."

The center of the storm past near and east of Havana at 11:30 p. m. of the 17th, with minimum barometer at Havana, 28.86 inches, and by the morning of the 18th had reached a position near and to the eastward of Key West, where at 3 a. m. a minimum barometric reading of 29.30 inches was registered. Moving thence northeastward to a point about opposite the South Carolina coast, the center recurved to the westward, *and was then forced southward over the Florida Peninsula* by an area of high barometer that covered the north Atlantic coast districts.

[1] Vol. XXXV, p. 215-218.

The italics are the present writer's and are used to call attention to the striking fact that the cyclone center, after proceeding toward the northeast, paused and *went back to Florida.* This is just what the high clouds said it did. Precisely at the time that their action lookt capricious they were closely following the law that appears to govern their movements. The cyclone advanced from Florida northeastward out into the Atlantic, and the radiating point of the high clouds at St. Croix answered by an advance from north to north-northeast; but now the cyclone, checked in its course, returns to Florida, and the radiating point of the high clouds at St. Croix thereupon falls back to the north. If we could fix the exact hours when the changes took place, both for the cyclone center and for the clouds, we should be able to tell just how long it took for the high currents to reach St. Croix from the vortex of the storm.

The notice of the storm from which the quotation is taken does not say what became of the cyclone after its return to Florida. According to the story of the high clouds, as told at St. Croix, it started once more on its movement over the Atlantic, and on this second occasion continued on its course for several days. If the high clouds were not on their trial, we might, after their accurate report about the recessional movement, take their word for the rest of the story; but as they are on their trial, all points must be supported by independent evidence. And as there is no evidence accessible, the latter part of the story must still remain unconfirmed.

(2) In the article in the May number it was remarked in connection with the above storm—

If it proves to be likely that there was a connection between the cirrus clouds and the cyclone in the above last-named case, then this connection existed at a distance of about 1,200 miles, the distance between St. Croix and Havana. That would be a very striking fact, if we could establish it.

Now it will perhaps be admitted that the remarkable agreement between the unusual movements of the cyclone center and the unusual movements of the high clouds, as above pointed out, amounts, when taken with the other facts, almost to a proof that the connection in question did exist when the cyclone left Florida and returned thereto. But the distance of the vortex from St. Croix must then have been about 1,100 miles, or nearly as great as the distance to Havana. Hence there seems to be strong ground for believing that the influence on the upper air of the movements taking place in the vortex of a cyclone extends even to such a great distance as 1,200 miles.

(3) In the same article, reference was made to some figures given by Mr. Page, in an earlier number of the MONTHLY WEATHER REVIEW, concerning the direction of cirrus cloud movements at Havana, but as the said earlier number was not then at hand the figures could not be quoted. They have since been found in the MONTHLY WEATHER REVIEW for July, 1904 (page 311). They represent Mr. Page's analysis of the frequency of upper cloud motions during hurricane months, as observed at Belen College, Havana, and are as follows:

Clouds.	Number of observations.	Percentage of frequency of movement from—			
		NE.	SE.	SW.	NW.
Upper	645	23	8	39	30

From this it will be seen that 69 per cent of the movements noted were from westerly points, while only 31 per cent, not quite one-third of the whole, were from easterly points, so that it is hard to see how Father Viñes could have arrived at the conclusion that there is a "superior general current which at that time of the year (the hurricane season) comes from the eastern quarter".

There seems to the present writer to be no evidence whatever for such a conclusion; but the truth appears to be that the normal direction of the upper current during the hurricane season, as at all other times, is from a westerly point, and that any deviation from this rule is to be lookt upon not as a mere freak, or accident, but as a phenomenon to be traced to a definite cause—that cause being, at all events in some cases, the presence and progress of a cyclonic depression.

Since writing the article to which the above remarks are offered as supplementary, we have had in the West Indies another hurricane season, and, altho no hurricane has occurred among the islands, we have seen here in St. Croix, during the season, no less than eight deviations of the high clouds from their usual course. Some of these were thru south round to the northeast quadrant, indicating perhaps, distant storms on the Atlantic, passing to the north of these Danish Islands; while others were thru north round to the above-named quadrant and indicated, it may be, storms originating in the Caribbean and passing northward.

So far there is very little evidence to connect any of the deviations, or "excursions", as we may perhaps call them, with cyclonic depressions.

The last three occurred in the latter part of September and in October; each was attended by a small fall in the barometer, and each October movement gave a little rain to St. Croix, on the 10th and 20th, respectively.

These three "excursions" are dealt with in the local newspaper (St. Croix Avis) of October 30 in the following article by the writer, which may serve to close the present paper:

Those of our readers who take an interest in weather studies will remember that in the last number of this paper we spoke of three excursions which the point of origin or radiating point of the high clouds had made from its normal position about west into the northeast quadrant, one in September and two in October. They were as follows:

1. The first excursion—commencing from southwest by west, going round to northeast, and lasting from the 23d to the 29th of September.
2. The second excursion—commencing from south-southwest on the 8th (with a temporary excursion to south-southeast) and going round to northeast by north, and lasting from the 8th to the 18th of October.
3. The third excursion—commencing from west-southwest and going round to northeast by north, and lasting from the 19th to the 25th of October.

From earlier comparisons of high cloud observations with the known and mapped out tracks of certain cyclones, we believe that each of these three excursions means the origin of a cyclone in the Caribbean, its subsequent passage from that sea to the Atlantic, and its farther movement in a northerly direction over that ocean. Sometimes there are excursions in the other direction, namely, round through south and east, but we need not consider them here.

But how are we to know that these swings of the radiating point of the high clouds through north round to northeast have the meaning ascribed to them. Evidently we can only come at it by finding out whether there were any actual cyclones answering to the theoretical description. In each of the three cases now under consideration the movement appears to have been of no great importance before or at the time of leaving the Caribbean, for we have heard of no storms among the islands to the west of us; if there were any, they were not of sufficient force to be destructive, or at all events not to any degree that was thought worth reporting. They entered the Atlantic quietly, but it remains to enquire whether they were developed there. From the duration of the high cloud excursions, and the radiating point going round as far as northeast, we should infer that in each case considerable energy was developed as the cyclone traveled northward, but what evidence is there to show that such was the fact. About the third one we have as yet no confirmatory tidings; but it is now (on the 29th) only four days since the influence of this movement on the high clouds here ceased, so the case may fairly claim a little delay. We deal therefore with the evidence for the *first* and *second* excursions.

1. Evidence bearing on the first excursion. In the Avis of Saturday last (26th instant) we adduced the case of the schooner *Carrie E. Bucknam*, which on the 1st of October, in latitude 37° 44′, with a gale blowing from northwest, appears to have had a cyclone center to the northeast of her. To-day we are able to bring what looks like fairly good evidence that a powerful cyclone passed up the Atlantic during the high cloud excursion which we now have under consideration. The New York Herald of the 1st of October gives some account of a storm which endangered the Atlantic fleet at Cape Cod on the night of the 29th of September. It was a gale from the east. That it was part of a cyclone is evident from the reference to the fact that storm signals had been hoisted; and it seems likely that the cyclone did not come off the continent, but up the Atlantic, for a short paragraph in the same paper speaks of the fears of the Navy Department for the safety of the seagoing tug *Lebanon* and the *Gloucester*, which were on their way from Pensacola, Fla., to the Navy Yard at Portsmouth, N. H., where the *Gloucester* was to be repaired.

Cape Cod is in latitude 42°. In the September cyclone of last year the storm center had reached about latitude 32° when its hold on the high clouds here was given up. Cape Cod is much (say nearly 700 miles) farther away; but then we must remember that the storm center was not at Cape Cod, but some distance south of it, and that it may have been moving very fast toward the north.

From all which it appears that, while the evidence looks very promising, we can not make proper comparisons or make sure of the case till we get further details, which may possibly come to hand later.

2. Evidence in regard to the second excursion (the first in October). In this case we have as yet only one piece of evidence, namely the experience of the *Guiana* on her recent trip from New York. The steamer left New York at 6 p. m. on Saturday the 12th instant to come south; about the same time, or perhaps on the previous day, the cyclone left the Caribbean to go north. If they should pass each other it would not be surprising. Accordingly, Tuesday night was rough. A gentleman who was one of her passengers informed us that he came on deck very early on Wednesday morning and observed three things, a strong wind from southwest, a considerable sea rolling in from southeast, and a dense bank of clouds toward the northeast. The barometer had dropped to 29.60 and the steamer had been slowed down a little during the night. We can see at once that a cyclone with its center some distance to the west of the steamer (100 or 200 miles, perhaps) had passed during the night. When in the morning the wind was southwest, the center was away to the northwest. The sea which came rolling in from the southeast had no doubt been raised by the wind in the cyclone's northeast quadrant, and the clouds to the northeast had been carried there by the southwest wind. As the steamer came south the conditions became rapidly better till she was once more sailing in fine weather.

Thus it will be seen that there is some evidence to confirm the theoretical views about excursions numbers one and two, and we may hope to get more later. For any confirmation in regard to excursion number three we must, as already intimated, wait a little longer.

A METHOD OF PRESERVING RAINFALL.

By J. CECIL ALTER, Assistant Observer. Dated Salt Lake City, Utah, November 4, 1907.

On April 16, 1907, I placed 0.20 inch of pure olive oil on 0.20 inch of water in the regulation Weather Bureau pattern 8-inch rain gage—with the funnel receiver, but without the inner tube—and exposed the gage in the regular support alongside the tipping-bucket gage. On November 3, 1907, I measured the contents of the gage, which amounted to 7.77 inches after deducting for the oil and the original water supporting the oil. The records in the office, obtained from the tipping-bucket gage during the same period of time, indicated a total precipitation of 8.03 inches—a discrepancy of 0.26 inch, or about 3 per cent, which was probably caused in part by evaporation; for after light showers, which are so frequent here, many tiny drops of water have been observed to lie sustained on the oil for a considerable length of time before sinking.

This experiment has been carefully made, and the results may be useful in solving the problem of obtaining records of precipitation in the unpopulated regions of the West.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

H. H. KIMBALL, Librarian.

The following titles have been selected from among the books recently received, as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies. Most of them can be loaned for a limited time to officials and employees who make application for them.

Baden. **Zentralbureau für Meteorologie und Hydrographie.**
Deutsches meteorologisches Jahrbuch. 1906. Karlsruhe. 1907. 75 p. f°.
Jahres-Bericht... 1906. Karlsruhe. 1907. 116 p. f°.

Birkeland, B. J.
Neue Feuchtigkeits-Tafeln für das Psychrometer unter dem Gefrierpunkt. Christiania. 1907. 33 p. 4°.

Budapest. Observatoire sismique.
Rapport annuel sur les observatoires sismiques des pays de la Sainte Couronne de Hongrie. Budapest. 1907. 11 p. 8°.
Dellenbaugh, Frederick S.
The romance of the Colorado river. xxxv, 399 p. 8°.
Great Britain. Meteorological office.
Hourly readings obtained from the self-recording instruments at four observatories in connection with the Meteorological office, 1906. London. xiii, 197 p. f°.
Hérault. Commission météorologique.
Bulletin météorologique. Année 1906. Montpellier 1907. 128 p. 4°.
Hesse. Grossherzogliche hydrographische Bureau.
Deutsches meteorologisches Jahrbuch... 1906. Darmstadt. 1907. [13], 59 p. f°.
Hoyt, John Clayton and Grover, Nathan Clifford.
River discharge. New York. 1907. vii, 137 p. 8°.
Milham, Willis I.
Cloud classification. 9 p. 8°. Williamstown. 1907.
Riefler, S.
Die Uhrenanlage der Hauptstation für Erdbebenforschung am physikalischen Staatslaboratorium zu Hamburg. Laibach. 1907. 12 p. 8°.

RECENT PAPERS BEARING ON METEOROLOGY.

H. H. KIMBALL, Librarian.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ——

American society of civil engineers. Proceedings. New York. v. 33. Dec., 1907.
Bruyn-Kops, J. de. Notes on rainfall at Savannah, Ga. p. 1101–1110. [Includes tabulation of all cases of excessive rainfall at Savannah, Ga., 1889–1906, inclusive.]
Electrical world. New York. v. 50. Dec. 7, 1907.
—— Lightning protection. p. 1083–1084. [Describes recent forms of lightning arrestors.]
Geographical journal. London. v. 30. Dec., 1907.
Woosnam, R. B. Ruwenzori and its life zones. p. 616–629. [Includes notes on the climate.]
Nature. London. v. 77. Dec. 12, 1907.
—— Experiments on wind pressure. p. 139–140. [Abstract of paper by T. E. Stanton.]
Royal society. Proceedings. London. Series A. v. 80. No. A 535.
Schuster, Arthur. The diurnal variation of terrestrial magnetism. p. 80–82.
Science abstracts. London. v. 10. Nov., 1907.
W[ilkinson], A. Air resistance. [Abstract of article by Joubet.] p. 567.
B[orns], H. Indian Ocean meteorology and the southwest monsoon. [Abstract of article by C. W. Brebner.] p. 590.
Scientific American supplement. New York. v. 64. Dec. 14, 1907.
—— Preventing frost on show windows. Cold-weather advice. p. 375.
—— Electric waves in the service of meteorology. [Abstract of paper by Guillén-Garcia describes the use of thunderstorm recorders in forecasting.] p. 382–383.
Stentzel, Arthur. The climate of Mars. Its effect on the habitability of the planet. p. 383.
Aérophile. Paris. 15 année. Nov., 1907.
Tatin, Victor. Les oiseaux, les aéroplanes et le coefficient de la résistance de l'air. p 309–312.
Soubies, Jacques. Physiologie de l'aéronaute. p. 316–317. [Abstract.]
Nature. Paris. 36 année. 14 déc., 1907. Supplement.
—— L'argon de l'air atmosphérique. p. 9. [Note on new method of extracting argon and the other rare gases of the atmosphere.]
Journal de physique. Paris. 4 série. Tome 6. Nov., 1907.
Trovato-Castorina, G. Sur la direction des décharges électriques atmosphériques dans les coups de foudre. p. 928. [Abstract.]
Meteorologische Zeitschrift. Braunschweig. Bd. 24. Nov. 1907.
Jaerisch, Paul. Zur Theorie der Luftdruckschwankungen auf Grund der hydrodynamischen Gleichungen in sphärischen Koordinaten. p. 481–498.
Teisserenc de Bort, Léon. Ueber dei Verteilung der Temperatur in der Atmosphäre am nördlichen Polarkreis und in Trappes. p. 498–499.
Hann, J. M. E. Stephan über Temperatur, Regen und Winde von Marseille. p. 500–501.
Hann, J. Die äquivalente Temperatur als klimatischer Faktor. p. 501–504.
Trabert, Wilhelm. Eine mögliche Ursache der geringen Temperaturabnahme in grossen Höhen. p. 504–506.
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STUDIES OF FROST AND ICE CRYSTALS.

By WILSON A. BENTLEY. Dated Jericho, Vt., May 28, 1906. Revised July, 1907.

(Continued from October Review.)

VIII.—CLASSIFICATION OF ICE CRYSTALS.

(67) List of types.

There are at least five different and characteristic types among the nuclear or germ ice crystals, and two or three additional post-nuclear types. In general, if growth is allowed to proceed for a sufficient length of time, each of these various germ types passes thru certain typical and characteristic growth phases peculiar to it. All, or nearly all, when first organized, possess smooth edges and contours, but they subsequently pass thru the scalloped, the ray, and the branch-like stages of growth before completion. These various types, because of peculiarities of form and resemblance to the objects after which they are named, may be grouped and named as follows:

1. Lanceolate .... Lance-like, MLA.
2. Discoidal .... Disc-like, MDB.
3. Solid hexagonal ...... Solid hexagonal plate-like, MHC.
4. Flower-like .... Ice flower-form, MFD.
5. Spandrelliform .... Resembling a spandrel, MSE.
6. Coralline............... Resembling coral, MCF.

Each of these respective types requires and will receive especial mention by itself in the text, in the order of relative frequency of occurrence of each in nature, so far as I have observed them at Jericho, Vt.

(68) Type MLA. Lanceolate ice crystals.

These lance-like or needle-like crystals are illustrated in

photographs Nos. 233 and 234. Some of the crystals are very long and slender and lance-like, others shorter and broader at the center than at the extremities, while still others broaden out so greatly at a central point along one of their edges as to suggest the idea that segments of disks had attached themselves to them. Perhaps those first mentioned occur most frequently. They usually form upon and shoot outward from some object, as from the edges and sides of ponds, brooks, and artificial receptacles holding water in process of freezing. Photographs Nos. 233 and 235 will convey an idea of their general aspect.

The very first ice crystals to form when water begins to freeze are almost invariably of this description. As these latter grow upon the surface, scallops and branches form and grow outward from one or both edges, as shown in photographs Nos. 235, 236, 237, and 238; and eventually grow in parallel rows downward into the water from their under sides, in the manner shown in photographs Nos. 239 A and 239 B. They are perhaps the main fabrics of the ice, as they alone merge and form ice films by themselves in addition to frequently combining with other types of ice crystals to form such films. The needle-like ice crystals that broaden out upon one edge at the center (see photograph No. 234) always form independent of a support in the free water, and proceed to grow in many cases in the manner shown in photograph No. 240, thru the formation of scallops around their edges. These scallops soon develop into rays and branches, and they pass into the branch-like state and continue their growth in a branch-like manner.

(69) Type MDB. Discoidal ice crystals.

These strange and most interesting crystals of ice come into visible existence in the form of tiny, round, thin, disks of ice of various dimensions, as shown in the photograph No. 241. Some seem to be perfectly flat, and others slightly concave. All are exceedingly thin, and when first formed look like tiny films or specks of oil resting upon the surface of the water. They vary somewhat one from another in size and form, and in the degree of perfection, or spheroidicity, of the disks. Ofttimes two or more crystals merge together while yet in the germ state and form many-lobed disks of irregular, unsymmetrical shapes. At this first stage discoidal crystals seem not to possess secondary axes and grow in a round and seemingly most uncrystal-like manner. But as growth progresses they soon come to the "parting of the ways", and grow differently. At this, their critical stage of growth, tiny scallops begin to form at certain equidistant points (six in number) around their edges. Photograph No. 242 shows them at this stage of growth. This is a most strange and fascinating period in their life history. Under the influence of continued cold and a more rapid rate of growth and of certain mysterious crystallic laws, seemingly latent influences become active, and they pass from the germ, or nuclear, into the mature, from the simple into the complex state of being; they acquire secondary axes, and grow afterward in a more truly crystal-like manner, and are more in accord with the hexagonal system of crystallization to which they belong. Scallops soon form around their whole circumference and grow rapidly larger, but those that first appeared grow much faster than the others. Photograph No. 243 shows them at this period of their growth. Eventually certain of the scallops push outward so far beyond the others as to give a star-like or flower-like appearance to the crystals, and they pass into the beautiful "ice flower" stage shown in photographs Nos. 244 and 245.

The next step consists in a marvelously rapid development of the six longer scallops or rays, which push outward far beyond the others and assume the role of primary rays; then follows the formation and growth of numerous secondary rays upon and around such primary rays. The beautiful appearance of such flower-shaped crystals, or "ice flowers", is well shown in photographs Nos. 246 and 247.

The final and last step in their development consists in a continuation of the growth of the main rays and the formation, or multiplication and growth of secondary rays thereon. This stage is well shown in the beautiful branch-like crystals portrayed in photographs Nos. 248, 249. The crystals attain their greatest beauty and complexity at this point, and such as may have developed apart by themselves and in a symmetrical manner, often possess a beauty and complexity of form and outline rivaling that of many of the branch-like snow crystals which they so greatly resemble.

(70) Type MHC. Solid hexagonal ice crystals.

Ice crystals of this form differ little from those last mentioned, except that they possess hexagonal forms, having sharp or but slightly rounded corners instead of circular forms and outlines as is the case with discoidal crystals. Examples of this and other types of crystals may be seen in photographs Nos. 241 and 250. They pass successively thru the scallop, the ray, and the branch-like states of growth as do the latter, but unlike them, begin and conduct their whole growth from the very first upon the hexagonal plan, upon and around secondary axes, in a manner similar to that of the snow crystals. Owing to crowding and early merging together individual ice crystals of this, and indeed of other descriptions, are rarely permitted under natural conditions to continue development for any considerable length of time in a perfectly symmetrical manner or to attain a very considerable size. But under artificial conditions, such as may be brought about in the case of ice crystals that are allowed to form and to grow upon the calm surface of the water (as in a pail of water in process of freezing), individual crystals of this and of other types can be kept apart from each other and allowed to grow by themselves, by removing any crystals that form or float into their immediate vicinity. Under such favorable conditions, they can be made to grow and develop into crystals of large size, and of great beauty, complexity, and symmetry of form.

(71) Type MFD. Flower-like ice crystals.

This type of ice crystal seems to begin at once in the hexagonal star or flower form. These are quite tiny at first, and of simple form, the usual germ form consisting of a tiny hexagonal star with six leaf-like petals, like the smaller crystals shown in photographs Nos. 250 and 251. They rarely remain long in this form. Scallops and secondary branches soon form upon and around the edges of each of the six primary petals and they pass into the branch-like stage, as shown in photographs Nos. 252 and 253. This type of crystal also assumes elegant and symmetrical branching forms if allowed to develop under favorable artificial or natural conditions.

(72) Type MSE. Spandrelliform ice crystals.

These singular ice crystals vary somewhat in form one from another, even when first organized. Commonly one edge is straight in contour, and the opposite one curving. The two edges often conspire to outline a hat-shaped or spandrel-like figure. Photograph No. 254 pictures a typical example. These strange forms, like other types, successively pass thru the scallop and the branch-like stages of growth. Photograph No. 255 shows them while in the scallop stage, and No. 256 pictures one after entering upon the branch-like stage.

Singularly enough, quite a few of these and also some crystals of the needle-form type, shown in photograph No. 234, grow outward from the corners toward the straight edge, and assume a horseshoe or meniscus-like form. Photograph No. 257 shows a spandrelliform crystal that developed in this strange manner, while No. 258 shows a needle-form crystal, and also the spandrelliform crystal at a later stage of growth, after it had grown in the manner just described. Why certain

isolated crystals of these respective types grow in the strange abnormal manner shown in the photographs is indeed most mysterious; and the mystery is heightened by the fact that it often happens that crystals of both of the respective types under consideration form and grow in a normal manner at the same time and upon the same body of water as those that develop abnormally.

(73) Type MCF. Coralline ice crystals.

This graceful and elegant type of ice crystal usually, if not invariably, forms upon and grows out from some preconstituted nucleus, as from some one or more of the other types, or from some irregular discoidal crystal germ. In general the coralline crystals seem rarely to grow from mature discoidal, hexagonal, or flower-shaped crystals; they seem to prefer the needle or lance-form ice crystals, or the spandrelliform crystals, as nuclei from which to develop. Coralline ice crystals consist of myriads of rounded, convoluted, disk-like outgrowths, clustered one outside another in such a manner as to form graceful curving branches, greatly resembling certain forms of coral. Their whole development occurs in a sinuous and meandering, rather than a straight and regular fashion, and in this regard they resemble the meandering type of window-ice crystals. Why these coral forms should grow in this seemingly uncrystal-like manner, upon the surface of water supporting growing needle-like, flower-like, and hexagonal ice crystals side by side with them, all of them growing in a crystal-like manner markedly unlike the coral forms, is indeed most strange and incomprehensible. Beautiful specimens of this type of ice crystal may be seen in photographs Nos. 259 and 260. No. 259 formed and grew from a tiny twin discoidal crystal similar to the one seen at one side of the coral-form ice crystal.

(74) Additional photographs of ice crystals.

The author's collection of photographs of ice crystals numbers over 200 and contains many beautiful and interesting forms, in addition to those already mentioned. It is thought best to select a few from among them to use for illustrative purposes. These added ones are Nos. 261, 262, 263, 264, and 265. No. 261 shows an interesting specimen of a twin discoidal ice crystal at a second stage; two circular discoidal crystals united together to produce it. No. 262 shows a very interesting group of ice crystals of various types. It shows how ice crystals of various types, sizes, etc., form and grow at the same time, side by side, upon a given body of calm, freezing water.

No. 263 is a photograph of a lenticular body of ice formed by the freezing of water in a shallow dish. In this case the water was frozen rapidly, and the ice crystals that accomplished the work formed around the edges of the dish and grew inward; hence the so-called air tubes within the ice, instead of forming with their longer radii normal to the surface of the water, formed for the most part parallel to the surface of the water. The forms and arrangement of the air tubes within this lens-shaped body of ice are well shown in the photograph.

Nos. 264 and 265 show how environment and crowding impair symmetrical growth, and how the segments of neighboring crystals lying farthest apart from such crystals as may be in their vicinity are stimulated in their growth by the proximity of relatively large areas of crystal-free spaces of chilled water surface, from which to draw material for new growth, while those segments that lie nearest adjoining crystals are retarded and hindered in their growth by such contiguity, and by a consequent lack of extensive areas of chilled surface water (water molecules) in their immediate vicinity from which to draw material for growth. They serve to establish the fact that growing ice crystals, resting upon the surface of the water, at first draw but little from beneath the surface of the water to aid in their growth; but that they draw material for their growth almost wholly from a thin film of chilled surface water.

IX.—HAIL.

(75) Probable manner of formation and classification.

It is well known that as a result of the action of certain meteorological forces and conditions, not yet well understood in all cases, a portion of the raindrops formed in summer during rain and thundershowers and tornadoes, and also in winter by the melting of snow crystals or snowflakes, is sometimes frozen in the air or in the clouds and converted into solid masses or accretions of ice called hail. In general, the forms, structures, sizes, degree of transparency or opacity, and presumable manner of origin of hailstones formed in winter vary in considerable degree from those produced in summer. Because of this, and also because in general winter hail is peculiarly the product of general snowstorms and of horizontal air currents, whereas summer hail is peculiarly the product of local rain and thundershowers and of violently ascending air currents, it is convenient and advisable to separate hailstones into two classes, winter hail and summer hail, according to the respective times of occurrence and manner of origin.

(76) Cause and occurrence of winter hail.

Because of its apparently greater relative frequency of occurrence, winter hail should perhaps receive mention first.

In general, winter hail is peculiarly the product of the eastern or southeastern segments of widespead general storms. Such storm segments seem to produce hail not always, but only in some cases. Whenever winter hail occurs the melting of the snow crystals, which presumably go to its upbuilding, is due to the presence of a warm but presumably relatively thin and somewhat elevated stratum of air lying between the earth and the clouds or between two low cloud strata. Such warm air currents almost certainly come from the south or east and flow spirally inward in a horizontal manner toward the centers of such storms between the colder air strata existing within such storms both above and below them. The melted snow that descends as liquid raindrops from the lower side of a warm air current freezes into hail while the drops are falling thru the cold substratum of air lying between the warm stratum and the earth.

Winter hail ofttimes occurs simultaneously over relatively large areas. In general, sleet or mixt sleet and rain precede and follow the occurrence of winter hail. Such hail usually occurs during southeast winds, when the temperature of the air at the earth's surface ranges from 23° to 35° F. The individual winter hailstones, tho occasionally of practically uniform size, in general vary somewhat in size and sphericity, both during a given storm and from one storm to another. Hailstones varying from one-thirtieth inch to one-eighth inch often fall together.

(77) Structure and forms of winter hailstones.

The interior structure of winter hailstones varies somewhat in different cases. All possess tiny air tubes and air bubbles, but some in greater quantity than others. Some contain but a few relatively large ones, others many small ones. Sometimes a tiny group of bubbles occurs clustered within their nuclear portions. In general, the larger air tubes radiate from the center outward. In most cases the majority of the air tubes are clustered at the center of each hailstone.

Winter hailstones assume various forms. The great majority are round, but some are egg-shaped, and pear-like shapes are not rare. These latter are of much interest. Pear-shaped hailstones are doubtless due to the fact that the larger spheroidal ones, because of their greater weight, fall downward faster than the smaller hailstones and the smaller undercooled raindrops, and hence overtake and merge with these. In some cases the tiny raindrops encountered are not too much undercooled to have time to spread around considerably upon

the hailstones before solidification takes place; but in others they are undercooled to such an extent as to freeze instantly upon impact. The latter cases presumably produce the pear-shaped hailstones.

The writer secured many interesting photographs of winter hailstones, and of sections of such stones, during the winter of 1906–7, a few of which are reproduced herein as illustrations. Nos. 267 B, 268 A, 268 B, 270, and 271 show the typical arrangement of the air tubes within the stones. No. 266 B shows a more diffuse and less common arrangement. Nos. 267 A, 268 A, and 269 A show whole pear-shaped hailstones, while 267 B, 268 B, and 269 B show sections of pear-shaped and oval-shaped stones under larger magnifications.

(78) Occurrence and cause of summer hail.

Summer hail seems to be peculiarly a product of violent summer showers, and especially of thundershowers and tornadoes and of violently expanding volumes of cloud-laden air. Newly formed or forming showers, or newly forming annexes to old ones, and those terrible rotating storms called tornadoes seem to be the principal, if not the only summer storms that produce hail. Unlike winter hail, summer hail occurs over very small areas and is a purely local phenomenon. Yet it frequently happens that hail occurs simultaneously, or on the same date, at various and perhaps widely separated points. Hence it may be presumed that in general the same peculiar causes that operate to produce hail within some particular shower of a series will operate at other points, and cause the formation of hail there also. In general the portion or segment of a given shower that produces hail is of relatively small area, hence the path of a hailstorm is quite narrow. Such hailstorm paths vary from perhaps a few hundred feet to as much, in some cases, as a mile or so in breadth. It seems to be the case usually, if not invariably, that the clouds extend to a very great height above the particular segment of a shower that produces hail. Probably in most cases such hail-producing clouds far overtop the surrounding clouds that produce rain only.

(79) Usual structure of summer hailstones.

Tho the individual summer hailstones occurring in the same or in different individual storms often vary markedly one from another in size and exterior form, yet in general their internal structures and appearances are quite characteristic and similar. The nuclei of most summer hailstones consist of whitish, more or less opaque and seemingly amorphous ice. In nearly all cases a coat of clear normal ice extends around and incloses the opaque nucleus, and, in the case of most large hailstones, many alternate coats or accretions of both clear and partly opaque amorphous ice seem to have been superimposed in alternate concentric order upon and around such nuclei. Because of this a cross section of a large hailstone presents a circular banded appearance. A great majority of the smaller summer hailstones are round, ovoidal, or pyramidal in shape. The larger ones are remarkably less regular in form than the smaller ones, and a larger percentage of these possess ovoidal, oblate, or irregular jagged forms. Small summer hailstones rarely merge or freeze together, but when, as usually happens, small and large ones occur together, the small ones frequently merge with the large ones and freeze in most varied order upon them.

(80) Peculiar structures.

Certain peculiar large egg-shaped and facetted hailstones possess such a post-nuclear structure as would seem naturally to suggest that the outer or post-nuclear portion was formed subsequent to the nucleus, as a result of the merging of many small hailstones. The absence of cavities within them, however, makes this theory of their origin untenable. Under the microscope the whitish, snow-like, nuclear ice and the concentric coats of post-nuclear ice are seen to be thickly threaded by air tubes chaotically arranged, by icy nodules, and by granular fibers resembling those of which granular amorphous snow is composed, or such as would likely result were the fibers partially melted. The forms, locations, and arrangements of these interior air tubes and of the other features that resemble nodules and fibers of granular amorphous snow, correspond so closely to the jagged granules and fibers of which actual natural granular amorphous snow is composed, as to leave little doubt but that they have such a snow origin, and were inclosed and eventually frozen within a liquid coating of ice-cold water surrounding a pellet of granular snow, all of which may be said to constitute a raindrop of "melted snow".

(81) Probable manner of formation of summer hail.

Assuming this to be the case, hailstorms not only have a granular snow origin, but as growth progresses in cloudland they must repeatedly and alternately encounter clouds of warm mist and cold snow. If we may judge of the origin and formation of summer hailstones by what seems to be revealed or indicated by their forms, size, structure, etc., then it would seem that they are, in general, formed in the manner described in the following paragraphs:

(*a*) The nuclei, or rather what eventually go to form such nuclei, are first organized in the form of pyramidal or star-shaped granular snow, within the central and upper portions of very lofty, violently and vertically expanding, mushroom-shaped cumulus, or cumulo-cirrus clouds. The rapidly ascending air currents within the central portions of such clouds may expand upward in some cases as internal whirlwinds, and in others very strongly but without marked rotary motion; but their upward motion is assumed to be so rapid as to enable them to sustain and carry along upward with them all the raindrops and granular snow that come within their grasp.

The pellets of granular snow are blown upward and expelled or released from the grasp of the powerful updraft air currents only at or near the summit and spreading portion of a cloud. Once the pellets reach the spreading-out portion of a cloud, they are blown outward in a horizontal, rather than upward in a vertical manner; thus they lose their ascensional motion and begin to fall earthward. The larger pellets and the larger hailstones, caused by melting and refreezing necessarily fall first and nearest to the central vortex, while the smaller pellets are blown farther outward into the spreading portion of the clouds, and fall earthward farther away from the center. Many of the latter eventually fall as rain completely to earth at some point beneath the shower clouds.

(*b*) A portion of the granular pellets, however, and especially the large ones such as fall closest to the central vortex, as they fall earthward and become partly melted at lower levels, encounter strong horizontal indraft air currents, and are drawn by them again into the shower vortex, and are again carried far upward and converted into ice, and recoated with granular snow, and eventually expelled again, as in the first instance, from the summit and spreading portions of the shower clouds. In some cases, as when the uprushing and whirling winds of the shower's central vortex are very swift, the hailstones may even once again undergo a descent and an ascent, as in the first and second instances. Or again, in their fall earthward they may encounter a secondary, newly-forming vortex, as an annex to the main one; and after being partly melted within its milder air, they may be carried far upward by it, again reaching cold, freezing altitudes and be once again frozen, before they become so heavy as finally to fall to earth.

In short, this theory[9] assumes that, in general, summer hailstones begin as granular snow, and are melted or partly melted only by partial descent, and are congealed only thru

[9] The author assures us that he arrived at this theory quite independently of suggestions from the very limited authorities and literature to which he had access.—EDITOR.

ascent within the clouds. The writer believes that the process of hail formation as herein described, or some modification of it, is capable of completely explaining all the various phenomena of summer hail. Surely powerful air currents or winds must blow upward thru and within hail-producing clouds to sustain and buoy up the larger hailstones for the length of time necessary for them to grow to so considerable a size.

[*To be continued.*]

THE WINDS OF THE LAKE REGION.

By Prof. ALFRED J. HENRY, United States Weather Bureau. Dated December 10, 1907.

All motions of the air depend directly or indirectly upon differences in temperature. Differences in temperature arise in several ways, mostly, however, as a result of the varying amount of solar energy received at the earth's surface in the various latitudes and the unequal heating of land and water surfaces. The temperature of the equatorial regions, for reasons that need not here be stated, is high as compared with that of the polar regions; as a consequence the isobaric surfaces are inclined toward the poles, and there is, therefore, a flow of the upper air from the equatorial regions poleward in both hemispheres, with a countercurrent in the lower air from the poles toward the equator. This interchanging motion between the equatorial and the polar regions is modified by the deflecting force of the earth's rotation, by differences in barometric pressure on different parallels of latitude, and by other causes which conspire to interrupt and at times reverse the general motions here indicated.

In the Northern Hemisphere, with which we are most concerned, the principal winds are (1) the northeast trades whose polar limits do not extend much above 30° north latitude, and (2) the prevailing westerly winds of the middle latitudes. Each of these winds forms an elemental part of the general circulation of the atmosphere, and is therefore controlled and modified by general rather than local influences.

The normal temperature gradient between the equator and the poles near the surface of the earth is the principal cause of the winds. It is subject to a rather large annual inequality—that is to say, it is strongest in winter and weakest in summer—consequently the winds, particularly of the middle latitudes, also show an annual inequality both in direction and velocity; and, moreover, they are interrupted by local and temporary disturbances in temperature which produce gradients strong enough to overcome the normal gradient for the time and place. These local and temporary disturbances occur most frequently in the warm season, when the equatorial-polar gradient is weakest; hence it follows that the winds are most variable in summer and steadiest in winter. Another cause for the general seasonal changes in the force and direction of the wind is the annual migration of the heat equator. The temperature differences which arise between the continents and the oceans, as a result of such migration, cause a corresponding movement of the lower portions of the atmosphere from the colder to the warmer region.

The meteorological stations in the Lake region from which the material for the following remarks was obtained are of two classes, viz, (1) the cooperative stations at which the prevailing direction of the wind by eye observations is recorded each day, and (2) the regular stations of the Weather Bureau where the direction and force of the wind is automatically recorded thruout each of the twenty-four hours. The Weather Bureau stations, with but one exception, are stationed along the Great Lakes. Since the direction of the wind is controlled at times by temperature differences that arise between contiguous surfaces of land and water, the local winds at lake stations may not always show the general movement of the air, but merely the direction and movement of the air within a narrow zone surrounding the lake. To meet this objection use has been made of a number of cooperative stations situated at some distance from the lakes.

Winds of the cold season.—In the cold season, viz, from November to March, the winds of the Great Lakes are controlled chiefly by the meteorological conditions which prevail in the interior of the continent. The general drift of the surface winds in the United States east of the Rocky Mountains and north of about the thirty-fifth parallel of latitude for this period is from a westerly quarter; more specifically, the winds of the upper Missouri Valley, the upper Mississippi Valley, and the northern portion of the upper Lake region are northwest; in the southern part of the upper Lake region, the lower Lake region, and the Ohio Valley, west or southwest, and in the Middle Atlantic States, northwest. The mean path of the prevailing winds[1] in these regions in winter is shown in fig. 1, No. 1.

As the meridional altitude of the sun increases, the thermal conditions which prevailed over the continent in winter become reversed; the interior becomes warmer than the oceans on the same parallels of latitude on both the east and west coasts and the Gulf of Mexico on the south. The consequence is, as pointed out by Ferrel,[2] the air over the interior of the continent becomes more rare than over the oceans, rises and flows out in all directions above; while the barometric pressure is diminished, and there is an inflow below from all sides to take its place. The effect of this general warming up is not sufficiently strong, however, completely to overcome and reverse the generally eastward drift of the atmosphere in these latitudes, but it is sufficiently powerful when the pressure gradients are weak to control the direction of the winds; hence, in the transitory months of spring and early summer the winds come alternately under the influence of (1) steep temperature and pressure gradients caused by the lingering cold of the continental interior, and (2) increasing solar radiation. The effect of the latter is seen mainly during intervals of clear weather and diminishing winds, which follow the passage of an area of high pressure and cold weather. As a consequence the winds of spring are more variable than those of winter, as may be seen from fig. 1, No. 2, where are charted the prevailing winds of spring.

An interesting fact in connection with the winds of spring is the beginning of what appears to be a slight monsoon influence on Lake Michigan, viz, onshore winds from April to September of each year, due in part, it is believed, to the difference of temperature which prevails between the lake surface and contiguous land surfaces, and in part to the prevailing pressure distribution in the late spring months.

The prevailing winds on the southwest shore of the lake, as may be seen from the data for Chicago, Table 1, are northeast from April to September; on the west shore, as at Milwaukee, northeast for April and May, and southeast from June to August, or from the lake to the land in both cases. At Escanaba, on Green Bay, the prevailing winds are northerly until May, then southerly from May to October, both inclusive. The prevailing winds at Grand Haven, the only available station on the east shore, are easterly in April and southwesterly from May to September, with, however, a large percentage of northwesterly winds in July and August. Thus it will be seen

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[1] The term "prevailing" unfortunately does not afford any indication of the relative frequency of the winds so designated. If the wind blew an equal number of times from each of the eight principal points of the compass, it would be said to have no prevailing direction, there being 12.5 per cent from each direction. If, on the other hand, it had blown as much as 13 per cent from any direction, that direction would be designated as the prevailing one. The term "prevailing" may, therefore, indicate winds of frequency ranging between 13 and 100 per cent. In Table 1 is given the percentage of wind from each of the eight principal points of the compass as determined hourly by automatically recording instruments.

[2] See "A Popular Treatise on the Winds".

that for the summer months, as graphically shown in fig. 1, No. 3, the winds are generally onshore. These onshore winds form about 20 per cent of the total winds observed. They prevail at times when the pressure gradients are weak, and subside as soon as stronger gradients appear. This exception should be noted. A pressure gradient that will produce a land wind on the west shore of the lake produces a lake wind on the east shore. The former are produced chiefly by the slow eastward drift of areas of high pressure across the Lake region in which the seat of greatest cold and highest pressure is found

in August, and to zero in October. In November the water temperatures along the shore are about 6° warmer than the corresponding air temperatures.

On the west shore of Lake Michigan the difference between land and lake temperatures is greatest in June and July, when it amounts to about 8° at Chicago, over 10° at Milwaukee, and about 6° at the Straits of Mackinaw. The difference diminishes steadily until October, when the water is warmer than the air at the Straits of Mackinaw, but still colder than the air over the southern and central portions of

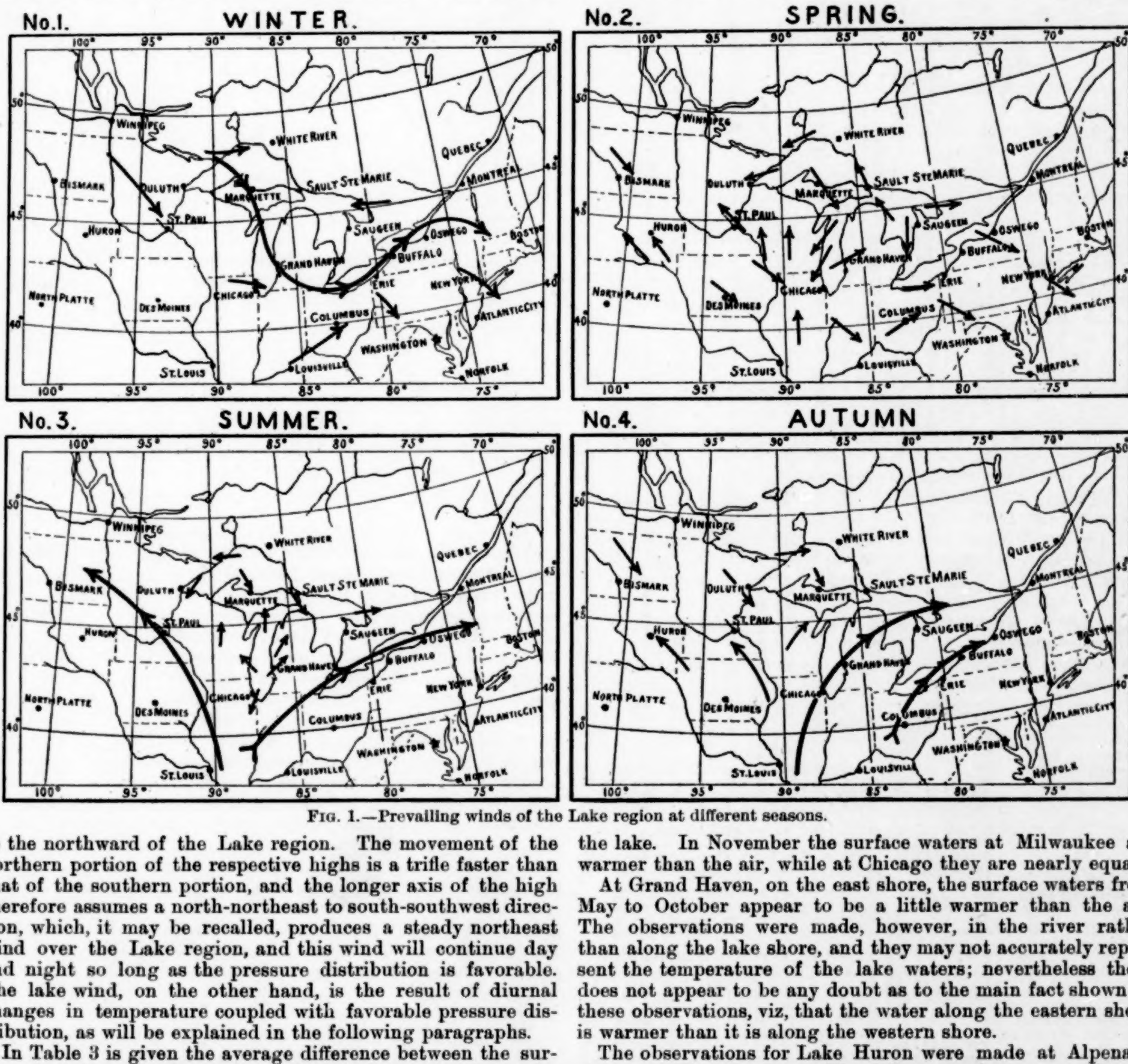

FIG. 1.—Prevailing winds of the Lake region at different seasons.

to the northward of the Lake region. The movement of the northern portion of the respective highs is a trifle faster than that of the southern portion, and the longer axis of the high therefore assumes a north-northeast to south-southwest direction, which, it may be recalled, produces a steady northeast wind over the Lake region, and this wind will continue day and night so long as the pressure distribution is favorable. The lake wind, on the other hand, is the result of diurnal changes in temperature coupled with favorable pressure distribution, as will be explained in the following paragraphs.

In Table 3 is given the average difference between the surface air and water temperatures at several stations along the Great Lakes. The period of observation was about five years in length, and the temperatures of both air and water were observed at the same moment of time.

These data show that the greatest differences between air and water temperatures are found along Lake Superior, where they amount to about 10° on the average for the months of May to July, inclusive, diminishing to about half that amount

the lake. In November the surface waters at Milwaukee are warmer than the air, while at Chicago they are nearly equal.

At Grand Haven, on the east shore, the surface waters from May to October appear to be a little warmer than the air; The observations were made, however, in the river rather than along the lake shore, and they may not accurately represent the temperature of the lake waters; nevertheless there does not appear to be any doubt as to the main fact shown by these observations, viz, that the water along the eastern shore is warmer than it is along the western shore.

The observations for Lake Huron were made at Alpena, a station on Thunder Bay. The differences here are uniformly small, perhaps due to poor circulation of water between the bay and the lake.

On Lake Erie there is a difference of about 5° during April, May, and June between the temperature of the air and the water along the shore, judging from the observations at Cleveland. For July, August, and September the air and lake temperatures are nearly the same, but in October

TABLE 1.—*Percentage of frequency of wind from the eight principal points of the compass (by the hourly records of self registers.)*

Stations and directions.		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
		%	%	%	%	%	%	%	%	%	%	%	%	%
Duluth, Minn.† (5 years, 1891-1895.)	N	10	9	8	8	10	7	11	11	10	12	10	11	10
	NE	8	14	25	44	38	28	21	20	20	19	10	6	21
	E	6	6	14	18	17	23	14	19	13	9	5	4	12
	SE	4	2	4	4	2	2	3	2	2	3	9	4	3
	S	5	3	3	1	2	3	3	3	2	2	6	5	3
	SW	17	19	14	4	7	6	10	13	19	12	20	23	14
	W	16	16	9	4	9	11	12	9	11	15	16	21	12
	NW	31	25	18	13	11	14	21	18	21	24	22	23	20
	Calm	3	6	4	4	6	5	5	4	2	3	2	2	4
Marquette, Mich. (10 years, 1894-1903.)	N	6	9	15	18	17	16	13	15	9	9	8	6	12
	NE	2	6	11	13	11	9	11	12	8	8	6	4	8
	E	2	4	4	5	5	7	6	6	4	3	2	2	4
	SE	8	6	9	10	10	11	9	9	10	12	8	6	9
	S	16	9	12	10	10	10	10	10	16	17	16	15	13
	SW	14	12	10	7	10	11	15	14	20	15	16	17	13
	W	23	22	11	8	7	8	11	12	13	13	21	26	15
	NW	29	31	26	27	29	25	24	20	21	21	24	25	25
	Calm	0	1	0	1	1	2	2	1	0	0	0	0	1
Port Arthur, Ont. (10 years, 1894-1903.)	N	5	5	10	11	13	8	8	8	8	6	9	4	8
	NE	6	7	17	21	23	20	19	17	11	13	6	5	14
	E	2	5	9	11	10	14	9	7	11	9	5	2	7
	SE	2	4	6	10	9	8	8	10	9	6	4	3	7
	S	3	3	3	1	3	4	4	3	5	5	4	3	3
	SW	11	11	9	4	4	5	7	8	10	7	12	14	8
	W	32	27	14	10	8	9	12	14	15	18	30	32	18
	NW	25	24	21	21	18	16	17	19	19	23	21	25	21
	Calm	15	13	11	12	13	16	15	14	12	13	9	12	14
Parry Sound, Ont. (10 years, 1894-1903.)	N	14	14	12	14	10	9	9	12	11	11	14	17	12
	NE	6	6	7	9	7	6	6	6	9	7	5	6	7
	E	21	16	16	14	15	11	13	13	11	18	18	23	16
	SE	12	8	10	8	7	5	6	7	12	13	12	11	9
	S	7	8	9	7	10	8	9	7	9	8	9	4	8
	SW	9	8	9	8	11	14	16	13	16	11	12	9	11
	W	17	24	23	22	24	30	27	29	20	19	18	17	22
	NW	9	11	9	11	8	8	7	6	9	11	11	9	9
	Calm	5	6	5	6	8	9	7	6	4	3	2	3	5
Milwaukee, Wis.† (5 years, 1891-1895.)	N	7	8	12	10	10	8	10	13	10	9	9	9	10
	NE	5	7	13	21	19	16	13	12	9	7	5	6	11
	E	2	3	6	14	12	12	12	9	7	3	3	2	7
	SE	9	10	13	18	18	20	20	20	17	15	7	6	14
	S	8	8	7	6	6	8	6	9	15	10	16	11	9
	SW	15	16	16	10	15	12	17	17	19	19	15	21	16
	W	26	26	14	8	11	12	11	9	10	15	20	22	15
	NW	28	24	18	13	10	9	8	11	14	20	23	23	17
	Calm	0	0	0	1	0	1	2	1	0	0	0	0	0
Chicago, Ill. (10 years, 1894-1903.)	N	7	9	12	14	11	9	8	8	9	10	9	8	9
	NE	7	9	16	25	24	25	23	24	15	13	10	7	17
	E	5	5	8	9	7	10	10	12	8	7	3	3	7
	SE	7	6	10	11	11	11	13	10	10	10	5	4	9
	S	15	11	14	15	16	13	11	12	21	19	20	15	15
	SW	17	13	14	10	16	15	18	17	17	16	17	21	16
	W	23	26	14	9	11	10	13	9	12	15	17	23	15
	NW	17	20	14	7	5	6	6	6	8	10	17	18	11
	Calm	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Haven, Mich.† (5 years, 1891-1895.)	N	10	12	10	9	7	6	8	11	8	15	8	8	9
	NE	8	10	13	9	7	4	10	8	8	7	10	10	9
	E	15	9	11	20	9	10	7	9	8	10	9	11	11
	SE	16	9	14	16	15	12	7	10	16	17	16	16	14
	S	4	6	10	6	9	7	6	6	9	4	6	6	7
	SW	15	19	15	16	29	24	24	23	27	16	19	24	21
	W	9	10	11	7	11	19	13	9	6	11	8	10	10
	NW	23	19	16	17	14	18	23	21	16	20	20	15	18
	Calm	0	1	0	0	0	0	1	2	0	0	0	0	0
Alpena, Mich.† (5 years, 1891-1895.)	N	6	7	12	12	13	9	7	11	5	6	5	5	8
	NE	4	4	5	7	8	9	5	7	4	4	5	5	5
	E	5	7	7	17	16	10	7	8	7	5	4	6	8
	SE	8	9	14	21	24	29	25	20	21	17	8	6	17
	S	11	9	7	8	6	6	9	8	12	11	16	12	9
	SW	12	11	10	4	7	8	10	11	16	18	20	24	13
	W	34	25	18	11	11	12	13	12	17	16	21	26	18
	NW	17	23	25	21	15	17	26	22	18	23	21	16	20
	Calm	3	2	2	1	1	0	0	1	1	0	0	0	1
Detroit, Mich. (10 years, 1894-1903.)	N	7	8	7	12	9	9	10	11	10	10	8	7	9
	NE	9	12	19	20	17	16	14	18	12	13	7	7	14
	E	6	5	10	12	12	12	9	11	7	8	3	3	8
	SE	5	4	7	7	8	6	6	7	8	8	6	4	6
	S	9	5	7	6	8	9	8	7	10	10	11	8	8
	SW	29	27	21	17	24	23	26	24	28	25	30	36	26
	W	24	25	17	18	13	16	16	12	15	16	22	22	17
	NW	12	15	11	11	8	9	11	10	10	11	13	11	11
	Calm	0	0	0	0	0	0	0	0	0	0	0	0	0
Buffalo, N. Y. (10 years, 1894-1903.)	N	5	5	7	8	6	6	7	8	9	8	8	4	7
	NE	5	7	10	12	11	8	8	9	9	9	6	7	8
	E	10	8	12	13	12	8	7	10	8	11	8	9	10
	SE	6	4	5	5	5	4	4	4	5	7	6	5	5
	S	10	9	11	9	8	9	9	10	15	13	12	11	10
	SW	20	23	21	24	29	31	30	25	24	21	20	22	24
	W	30	32	24	19	23	26	26	22	21	19	26	29	25
	NW	14	12	10	9	7	7	8	10	9	13	15	12	10
	Calm	0	0	0	0	0	0	1	2	6	0	0	0	0

† Unfortunately the detailed records from self-registers at these stations were not tabulated after 1895.

TABLE 2.—*Percentage of westerly and easterly winds in the Lake region.*
(From Table 1.)

Station and direction.	Winter.	Spring.	Summer.	Autumn.	Year.
St. Paul, Minn.:	%	%	%	%	%
Westerly	57	40	42	44	46
Easterly	26	39	34	32	33
Duluth, Minn.:					
Westerly	64	30	38	53	46
Easterly	18	55	44	30	37
Marquette, Mich.:					
Westerly	66	45	47	55	53
Easterly	13	26	27	20	21
Milwaukee, Wis.:					
Westerly	67	38	35	52	48
Easterly	17	45	45	24	33
Chicago, Ill.:					
Westerly	59	33	33	43	42
Easterly	18	40	46	27	33
Grand Haven, Mich.:					
Westerly	48	45	58	48	50
Easterly	35	38	26	34	33
Alpena, Mich.:					
Westerly	63	41	44	57	51
Easterly	18	40	40	25	31
Detroit, Mich.:					
Westerly	67	45	49	56	54
Easterly	18	38	33	24	28
Buffalo, N. Y.:					
Westerly	65	55	62	56	59
Easterly	20	28	21	23	23

TABLE 3.—*Differences between air and water temperature in the Lake region.*
(Averages of about five years.)
("+" = air warmer than water; "—" = water warmer than air.)

Station.	March.	April.	May.	June.	July.	August.	September.	October.	November.
Lake Superior:	°	°	°	°	°	°	°	°	°
Duluth	....	....	+12.8	+ 8.4	+ 9.7	+4.2	+3.1	+0.4	—7.2
Marquette	....	....	+ 9.2	+12.2	+10.5	+6.4	+6.6	+1.3	—5.1
Lake Michigan:									
Milwaukee	....	....	+ 6.4	+ 9.3	+12.3	+6.5	+6.9	+1.8	—2.1
Chicago	....	+3.9	+ 3.5	+ 7.5	+ 8.4	+3.8	+4.7	+2.2	+0.4
Grand Haven	+1.8	+1.4	— 2.5	— 2.7	— 2.8	—2.6	—0.4	—0.1	+0.9
Lake Huron:									
Alpena	....	....	+ 0.7	+ 1.4	+ 1.7	+1.2	+2.2	+2.0	....
Lake Erie:									
Cleveland	....	+6.1	+ 5.0	+ 4.9	+ 0.9	+0.8	+1.8	—0.4	—2.4
Buffalo	....	+3.7	+ 4.9	+ 3.2	— 0.2	—0.2	+0.6	—1.8	—1.6

and November the lake water is somewhat warmer than the air. Observations made at Sandusky and Toledo both show less variation than at Cleveland, but, as at Alpena, the difference may be ascribed to local causes.

All water temperatures here mentioned refer to the temperature as determined along the shore, generally in shallow water. The temperature of the surface water in mid-lake is known to be considerably lower, especially on Lake Superior.

Since the surface layers of air over the Great Lakes take their temperature largely from that of the water with which they are immediately in contact, there must be a comparatively shallow body of relatively cold air overlying each of the larger lakes, corresponding to the area of low water temperature in mid-lake. The central portion of this mass of cooler air, in the absence of strong pressure gradients, must be a region of calms or light airs, while the air near shore, being subject to the control exercised by the diurnal contrasts in temperature over the land, the latter being greater than over the lake, must tend to move from the lake toward the land in response to the gradient. The winds thus created are known as lake winds. They arise mostly in the forenoon hours of tranquil summer days and continue for a few hours after sunset, when they shift to a land quarter.

The lake winds thus described are confined mostly to the west shore of Lake Michigan, where it may be remembered the prevailing wind at land stations is in a contrary direction, viz, from southwest to south.

The temperature gradients that will produce an easterly wind on the western shore of Lake Michigan, on the hypothesis of a region of relatively cool air in mid-lake, will produce a westerly wind along the east shore of the lake, and this local and temporary influence, uniting with the forces which maintain the general circulation of the atmosphere in the latitudes

of the Lake region, will cause an excess of westerly winds along the eastern shore as compared with the western shore. (Compare the summer winds at Milwaukee and Grand Haven, Table 2. See also the record for Parry Sound.)

The winds of summer.—In summer the prevailing winds of the Lake region are southwest to south, except on Lake Superior, where the direction seems to be controlled by local causes. The northeast winds of spring along the northwest shore of that lake from Duluth to Port Arthur continue well into the summer. The winds along the south shore are generally northwest.

The southerly winds of the lower Mississippi Valley apparently divide into two branches in late spring, one branch forming the southeast winds of summer in the Missouri Valley and the Plains, the other the southwest winds of the Ohio Valley and the lower Lakes.

The temperature of the surface waters of the Great Lakes reaches a maximum on lakes Erie and Ontario in July; on the larger lakes, Michigan, Huron, and Superior, the maximum is deferred until August. The closest agreement between air and water temperatures occurs in October.

The winds of autumn.—The autumn, as a whole, is a season of diminished temperature contrasts between land and lake surfaces, respectively, and accordingly we find that the lakes exert the minimum effect upon the direction of the winds at this season of the year. In autumn southerly winds reach their farthest northing, extending well into the Lake Superior region and the Province of Cntario to the northward. In November there is a sharp change in the direction of the wind in northern Wisconsin and the upper portion of the Lower Michigan Peninsula. In this territory northwesterly winds gain the ascendancy and maintain it thruout the winter. In the southern portion of the Lake region the winds in November become westerly and hold that direction until the succeeding spring.

One other point remains to be mentioned, viz, the probable effect of the contour of the several lake basins on the direction of the wind. The tendency of the surface winds to follow the course of a valley is well known. The lower Lakes, together with their connecting rivers, form a great shallow depression, which, on account of the diminished friction afforded by the water surfaces, must provide an easy path for the winds—a path, moreover, which it seems probable all winds between west and north follow unless compelled by strong pressure and temperature gradients to cross the lakes obliquely.

The average hourly velocity.—The average hourly velocity of the wind in the Lake region on the mean of the year is about 10 miles an hour. The wind velocity during the twenty-four hours is not constant, but increases from a minimum in the early morning to a maximum in the afternoon at about the same time that the maximum temperature occurs; indeed the resemblance between the curves showing the daily march of the temperature and the daily increase in the wind velocity is quite marked.

The wind in autumn and winter is above the daily average about eight hours out of the twenty-four and below the remainder of the time. In spring and summer it is above the daily average about ten hours out of the twenty-four and below the remaining fourteen hours.

The periodic diurnal range of the velocity of the wind is least in winter and greatest in spring and summer; thus the average range at six stations for January is 2 miles; for April 4.5 miles; for July 4.6 miles; and for October 3.4 miles. Another way of expressing this fact is to say that the winds of winter are steadier than those of spring and summer in the sense that the day and night winds are nearly equal in force. In the summer the winds of the nighttime fall as much as 4 or 5 miles an hour, on the average, below those of the afternoon.

The diurnal period of the winds at Marquette and Cleveland differs from that of other stations in that the daily minimum falls in the early evening hours instead of the early morning hours. At Marquette the minimum wind force of the day is experienced at about 5 p. m. in January; 9 p. m. in April; 8 p. m. in July; and 6 p. m. in October. At Cleveland the minimum occurs at 6 p. m. in January; at 7 p. m. in April; at 8 p. m. in July; and at 6 p. m. in October. The Marquette station also shows a prominent increase from the evening minimum to the secondary maximum in the early morning hours, a feature not generally observed elsewhere. The early minimum at Marquette is well marked, the average difference between it and the morning secondary minimum in July being about 3 miles. Its cause is not clearly understood.

The wind velocities given in Table 4 are subject to a correction for the varying altitude of the anemometers above the surface of the ground. In general, the greater the height the greater the velocity, other things being equal, but thus far no satisfactory correction for altitude has been determined.

TABLE 4.—*Average hourly wind velocity in the Lake region, in miles and tenths per hour.*

(For the period 1891-95.)

Station.	January.			April.			July.			October.			Year.		
	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.
St. Paul, Minn.	8.7	6.1	7.4	11.5	7.1	8.9	9.3	4.4	6.5	10.4	6.4	7.9	9.9	6.1	7.6
Marquette, Mich	10.7	8.8	10.0	12.6	7.5	9 7	10.5	5.3	8.6	13.5	10.4	11.7	11.8	8.6	10.2
Chicago, Ill	18.9	16.3	17.7	20.9	17.6	18.9	15.5	12.3	14.0	18.9	16.4	17.4	18.6	16.5	17.8
Detroit, Mich	13.1	10.4	11.3	14.5	9.8	11.7	12.2	6.9	8.9	13.8	9.9	11.3	13.4	9.4	10.9
Cleveland, Ohio	13.1	11.6	12.3	13.9	9.7	11.3	11.8	7.7	9.5	14.3	11.2	13.0	13.7	10.4	11.9
Buffalo, N. Y	14.8	12.9	13.8	13.1	8.8	10.5	12.7	6.9	9.4	13.9	10.7	12.1	13.4	10.2	11.4

The significance of the figures of wind velocities, given in Table 4, is as follows: In the column headed "highest" the figures represent the average for that one of the afternoon hours which gives the highest value; and, conversely, the figures under the column headed "lowest" express the average for that one of the night hours which gives the lowest value. The values under the column headed "mean" are the arithmetical means of all of the hourly readings in the month, 744 in the case of a 31-day month, etc.

The elevations of the anemometers above the ground during the period of observations, 1891–95, were as follows:

Station.	Height above ground Jan. 1, 1891.	Subsequent changes.
	Feet.	
Buffalo, N. Y	108	Increased to 123 feet October 7, 1895.
Chicago, Ill	272	Increased to 274 feet October 15, 1892.
Cleveland, Ohio	103	Increased to 130 feet April 3, 1892.
Detroit, Mich	158	Increased to 161 feet July 31, 1891.
Marquette, Mich	95	No change.
St. Paul, Minn	124	No change.

The wind movement is greatest on the average in spring and autumn, altho high single velocities, or squall winds, may occur in any month of the year. Table 5 contains a list of high wind velocities recorded in the Lake region within the season of navigation during the last thirty-six years.

High winds in the Lake region.—A cursory examination of Table 5 brings out the important fact that the storm winds of the Great Lakes, for a single season, are largely sporadic, and in general not confined to any particular quarter, altho, as a rule, westerly winds predominate. The storms which produce high winds in the Lake region may be divided into three main groups. In the first group may be included all storms whose centers move eastward north of Lake Superior; in the second may be included storms which approach the Lake region from the south or southwest, or whose centers approach from the west, but south of Lake Superior; and, finally, in the last group

TABLE 5.—*Maximum wind velocities (in miles per hour) in the Lake region during season of navigation.*

Station and period of record.	April.				May.				June.				July.			
	Velocity.	Direction.	Year.	Date.	Velocity.	Direction.	Year.	Date.	Velocity.	Direction.	Year.	Date.	Velocity.	Direction.	Year.	Date.
Lake Superior.																
Duluth (1871-06)....	60	nw.	1877	20	60	ne.	1877	20	63	ne.	1904	3	48	nw.	1897*	2
Marquette (1871-06)	49	w.	1891	30	52	se.	1896*	25	45	se.	1899	13	68	sw.	1901	20
S.Ste.Marie(1888-06)	60	se.	1893	20	50	se.	1892	18	45	nw.	1898	1	42	nw.	1898	28
Lake Michigan.																
Milwaukee (1871-06)	54	sw.	1878	10	49	se.	1896	25	60	sw.	1880	4	60	sw.	1874	24
Chicago (1871-06)...	72	ne.	1893	20	62	e.	1894	18	72	nw.	1892	13	72	w.	1897	5
Escanaba (1871-06).	48	n.	1878*	10	40	w.	1906	31	40	s.	1876	18	37	nw.	1901	20
Lake Huron.																
Alpena (1873-06) ...	49	nw.	1893	4	44	nw.	1905	9	48	w.	1881	13	60	sw.	1875	15
Port Huron (1874-06)	60	sw.	1893	13	54	sw.	1896	17	52	w.	1898	12	56	n.	1879	11
Detroit River.																
Detroit (1871-06) ...	72	ne.	1893	20	74	sw.	1893	23	60	nw.	1890	17	54	n.	1893	7
Lake Erie.																
Toledo (1871-06)....	60	w.	1892	5	52	e.	1882	6	50	w.	1888	13	49	nw.	1892	24
Sandusky (1877-06).	52	nw.	1880	19	46	nw.	1878	10	57	nw.	1882	29	69	n.	1879	11
Cleveland (1871-06).	60	n.	1901	20	60	nw.	1905*	11	60	nw.	1898	12	66	w.	1896	26
Erie (1873-06)......	60	se.	1894	10	60	s.	1875	....	40	w.	1899	7	56	w.	1876	....
Buffalo (1871-06) ...	57	sw.	1897	20	58	sw.	1884	2	56	sw.	1893	11	60	sw.	1876	5
Lake Ontario.																
Oswego (1871-06)...	54	se.	1893	29	40	se.	1894	20	36	ne.	1885	5	38	n.	1888	11

Station and period of record.	August.				September.				October.				November.			
	Velocity.	Direction.	Year.	Date.	Velocity.	Direction.	Year.	Date.	Velocity.	Direction.	Year.	Date.	Velocity.	Direction.	Year.	Date.
Lake Superior.																
Duluth (1871-06)....	51	nw.	1904	19	78	ne.	1881	16	55	ne.	1896	30	70	nw.	1905	24
Marquette (1871-06)	48	sw.	1890	2	61	s.	1893	21	48	sw.	1905	7	48	sw.	1894	14
S.Ste.Marie(1888-06)	50	nw.	1897*	29	56	nw.	1904	30	50	nw.	1893	14	52	nw.	1896	18
Lake Michigan.																
Milwaukee (1871-06)	52	w.	1896	9	48	w.	1890	20	60	sw.	1880	16	55	se.	1906	16
Chicago (1871-06)...	72	sw.	1898	16	72	sw.	1900	11	63	se.	1898	19	76	s.	1898	7
Escanaba (1871-06).	44	n.	1875	20	46	w.	1906	11	45	sw.	1880	16	60	n.	1877	8
Lake Huron.																
Alpena (1873-06) ...	41	nw.	1901	29	48	w.	1884	10	52	e.	1905	20	50	sw.	1874	5
Port Huron (1874-06)	52	n.	1896	8	46	sw.	1900*	11	54	sw.	1887	24	58	sw.	1894	26
Detroit River.																
Detroit (1871-06) ...	40	sw.	1904	20	43	sw.	1900	11	61	nw.	1891	31	76	sw.	1895	26
Lake Erie.																
Toledo (1871-06)....	45	ne.	1875	1	60	s.	1898	24	60	w.	1906	27	68	sw.	1906	21
Sandusky (1877-06).	63	ne.	1885	9	52	nw.	1897	16	54	n.	1885	29	62	nw.	1879	20
Cleveland (1871-06).	58	nw.	1896	10	66	nw.	1897	16	62	nw.	1894	11	73	s.	1895	26
Erie (1873-06)......	40	w.	1895	28	45	sw.	1895	12	48	w.	1887	24	54	w.	1891	23
Buffalo (1871-06) ...	58	sw.	1904	20	78	w.	1900	12	75	sw.	1906	28	80	w.	1900	21
Lake Ontario.																
Oswego (1871-06)...	51	n.	1893	29	51	nw.	1892	26	56	se.	1893	14	48	w.	1900*	21

* Also other years.

may be included storms which occasionally move northward along the Atlantic coast, increasing in energy as they reach higher latitudes, and frequently curving inland over the eastern portion of the Middle Atlantic States, as on November 13, 1904.

The storms of the first group are by far the most numerous and the least dangerous. The storms of the second group are not so numerous as those of the first, but they are generally attended by dangerous winds, at least over some portion of the Lake region. Storms of the third group rarely affect the upper lakes, but they cause dangerous winds over lakes Erie and Ontario.

Rarely does it happen that a storm, no matter to which of the above-mentioned groups it may belong, is equally severe in all portions of the Lake region. In the summer season, however, thunderstorms may prevail over the entire Lake region on the same day.

INFLUENCE OF VEGETATION IN CAUSING RAIN.

The following correspondence is published as a matter of interest to many readers:

Allow me to ask your valued opinion on the following matter: Admitting two clouds equally saturated with humidity to hang above two soils, the one teeming with luxuriant vegetation, the other barren and naked, parched by the sun, exuding heat, is the probability greater or not of the cloud in the first instance discharging itself in rain? Or, in other words, do the trees and the greater humidity of the one soil exercise no influence whatever in attracting rain?

* * * You assume two clouds hanging above two different regions, in one of which the soil has a luxuriant vegetation, while the other is barren, naked, and hot; and you ask whether the soil or the vegetation has any influence in "attracting rain".

If the clouds were low down, close to the soil, the warm, hot soil would doubtless contribute a little heat to evaporate the cloud particles and prevent rain, and by thus giving the cloud greater buoyancy the latter might rise a little higher. But neither the wet soil nor the dry soil would be likely to cause any rain.

If you have in mind the ordinary cumulus cloud, which is several thousand feet above the ground, then dry soils and moist soils would have no influence whatever upon the clouds, unless the areas of these dry and wet regions were extensive, such as a hundred miles square, in which case the great mass of warm, dry air would prevent the formation of rain, while on the other hand the mass of warm, moist air would not prevent rain, but would be helpful in case other circumstances conspired.

Neither dry land nor vegetation has any power whatever to "attract rain" from the clouds. If the raindrops are in the clouds they will fall toward the ground by the attraction of gravitation—not by any special attractive power of trees or soils. They will undoubtedly begin to fall in the clouds as soon as they are formed, and the fundamental question is, "How can we make the cloud particles join together into raindrops?" and not, "How can we attract the drops out of the cloud?" So far as meteorologists know at the present time the only place in which raindrops are formed in the warm climates of the globe, or warm seasons of the year, is in the midst of a rapid, ascending current of air. And if you notice that rain falls over a wet soil, rather than over a dry one, you will undoubtedly find that there are ascending currents of air over the wet soil, and descending currents over the dry soil. A descending current warms the air and prevents the formation of raindrops just as truly as an ascending current cools the air and favors the formation.

It is not worth while to appeal to electrical attraction or any other principle in physics, except the cooling by ascent and the mixing of air currents in cloudy regions where temperatures are but little above freezing.

Altho we do not know the exact details of the method of forming raindrops, as distinguished from fine cloud particles, yet it is safe to say that ascending and mixing are the important items, and that when once formed the drops will fall toward the ground. On their way down thru a stratum of very hot, dry air they may evaporate, so that the observer sees the streaks of falling rain, but gets none. In such cases the moist soil is *favorable to the preservation of the raindrops as such*, but we can not say that it *attracts* them from the cloud. This is quite an ordinary case in dry countries. In these cases the moisture is brought from a great distance—a hundred or a thousand miles—by currents of air that are slowly rising and rolling over and over on themselves. The upper part of the roll makes a cloud, the lower part is clear air. Raindrops are formed either slightly at nighttime, when the top of the cloud cools down in the absence of sunshine, or more freely in the daytime, when the vertical extent of the roll is greatly increased by the sun's heat. If in the daytime the overturning extends from sea level upward, then enough moisture is carried up to form a thunderstorm.

I do not see how man can possibly exert any appreciable influence on the formation of rain in your region. The forces involved in this atmospheric overturning, even in the smallest thunderstorm, are enormous. More energy is involved than is represented by all the steam engines in the world. The

best that can be done is to save the water that falls in wet regions and use it to irrigate in dry. An alternative method is to shade the dry regions from the midday heat and wind, so as to diminish the loss of moisture by evaporation.

WEATHER BUREAU MEN AS EDUCATORS.

In the Department of Agriculture number of the Vermont Bulletin, the official publication of the University of Vermont and State Agricultural College, we find the following synopsis of the courses in meteorology given by Mr. W. H. Alexander, local forecaster, Burlington, Vt.:

1. Elementary Meteorology: The atmosphere; its moisture; dew; frost; haze; fog; clouds; precipitation; winds; cyclones; thunderstorms; climate; weather; weather bureaus. The use of ordinary meteorological instruments; observations; the construction and study of weather maps. Lectures, recitations, laboratory. *Elective, one hour, Junior or Senior, second half.*

2. Advanced Meteorology.—Theories relative to various meteorological phenomena; the law of storms; application of the principles of meteorology to the interpretation of climates; climate as a factor in social and economic problems. Discussion of charts, diagrams, photographs; conduct of a series of meteorological observations; weather forecasting. Lectures, theses, laboratory. *Elective, two hours, Junior or Senior, first half.*

Mr. M. L. Fuller, observer, Canton, N. Y., reports that in the new State Agricultural School of St. Lawrence University he is to give considerable instruction. It is intended to introduce lectures on climatology and the work of the Weather Bureau early in the course, and to make the instruction in these lines as extensive as practicable.

Mr. George Reeder, section director, Columbia, Mo., reports that he has been appointed lecturer on climatology at the University of Missouri.

Mr. G. N. Salisbury, section director, Seattle, Wash., reports that his regular course of instruction in practical meteorology at the State University was given to a class of 7, and consisted of a series of 14 lessons of two to three hours each, extending from October 11, 1906, to January 24, 1907. The work comprised impromptu talks, quizzes, and laboratory work, which embraced observations, and the drawing and study of weather maps.

On June 26, 1907, instruction in elementary meteorology was begun with a class of 10 at the summer school of the university. The course comprised 16 lessons of two hours each, three times a week. Davis's Elementary Meteorology was used as a textbook, and was supplemented by talks and laboratory work.

Mr. A. H. Thiessen, section director, Raleigh, N. C., reports that the president of the Agricultural and Mechanical College, at West Raleigh, has authorized the expenditure of $50 for lantern slides to be used in giving instruction in meteorology and climatology to the students of that college. There seems to be an increasing desire on the part of the students to take up this study.

Mr. J. R. Weeks, local forecaster, Binghamton, N. Y., reports that on July 25 he had the pleasure of visiting Mr. DeLancy M. Ellis, Chief of the Division of Visual Instruction, New York State Department of Education, at his office in the Capitol at Albany. This division has charge of the work in the schools of the State relating to the use of lantern slides, pictures, photographs, etc., as a means of instruction. Until recently, however, no attempt was made to furnish material of this nature for use in physical geography classes, and the views used were of descriptive geography or of a general nature, a collection of over 25,000 selected negatives having been made from which sets of beautiful colored slides for use in the stereopticon are issued to the schools, about $20,000 being spent yearly by the State for the purpose.

But now, in addition to the lecture entitled "The weather, what it is and how it is observed and forecast", which, beginning with February last, has been loaned free to such schools as request it, by cooperation between the United States Weather Bureau and the New York State Department of Education, Division of Visual Instruction, Mr. Ellis is now selecting the negatives and having prepared in his office a beautiful set of colored slides illustrating four divisions of physical geography study—the earth as a globe, the atmosphere, the geosphere, and the hydrosphere. The entire series, containing, when completed, several hundred views, will be reproduced in large numbers and the duplicates deposited in many of the public high schools of the State for permanent use. These stereopticon views are not intended for lectures simply, but are to take the place of wall maps, charts, and pictures for daily class room use. For instance, in looking over the nucleus of the collection Mr. Weeks was shown a number of beautiful colored photographic reproductions, in the form of lantern slides, of the charts of isotherms, isobars, rainfall, etc., for the world, found in Bartholomew's Physical Atlas, permission to make them having been kindly granted by the publishers. These, like most weather maps and charts, are too complicated and rich in detail for ordinary lecture use, but are unexcelled for daily class room study. Publications of the U. S. Weather Bureau, Davis's Meteorology, Hann's Lehrbuch, etc., have also been freely drawn upon for reliable diagrams and charts, and striking views showing contrasts of weather influence on humanity and on vegetation have been selected from the best collections of many travellers. Helpful pamphlets are to accompany the series, and Mr. Ellis expects to visit many of the schools in the interest of this work.

In regard to public lectures and reviews, Mr. Ellis said that enthusiastic letters had been received by him from users of the Weather Bureau lecture, and that it is desired to continue permanently the plan adopted this year and approved by the Chief of Bureau.

Mr. Weeks further reports that this lecture, prepared by himself, entitled "The weather, what it is and how it is observed and forecast", continues in great demand, requests for it coming not only from all parts of New York, but from Nebraska and other States, so that the use of text and slides is usually arranged for several weeks in the future.

The following lectures and addresses by Weather Bureau men have been reported:

Mr. George S. Bliss, of the Philadelphia, Pa., office, March 20, 1907, before the physics class at George School, Pa., on "The work of the Weather Bureau"; May 2, 1907, at Darlington Seminary, West Chester, Pa., on "The causes and controlling forces of storms"; also June 22, 1907, before the Brandywine Grange, at West Chester, Pa., on "Methods of weather forecasting".

Mr. M. E. Blystone, October 2, 1907, before the Men's Club of the Trinity Union Methodist Episcopal Church at Providence, R. I.; October 15, 1907, before the Men's Club of the Episcopal Church at Pontiac, R. I.; also October 16, 1907, before the Men's Club of the Broadway Baptist Church of Providence, R. I., on "Weather forecasts".

Mr. W. T. Blythe, of the Indianapolis, Ind., office, October 30, 1907, before the Young Men's Christian Association at Peru, Ind., on "Meteorology and the work of the U. S. Weather Bureau".

Prof. H. J. Cox, April 9, 1907, before the Chicago Yacht Owner's Association, on "Wind squalls"; also August 13, 1907, before the Wisconsin Cranberry Growers' Association, at Cranmoor, Wis., on "Temperature and frost conditions in cranberry marshes".

Mr. H. W. Richardson, October 23, 1907, before the Ladies'

Guild, Holy Apostles Episcopal Church, West Duluth, Minn., on "The U. S. Weather Bureau and its work"; also November 30, 1907, before the Saturday Club, at the Duluth Carnegie Library Building, on "The Weather Bureau".

Mr. M. R. Sanford, August 9, 1907, before the summer school of Syracuse University, on "The work of the Weather Bureau".

Mr. R. H. Sullivan, November 21, 1907, before the Wichita, Kans., Chamber of Commerce, on "The work of the Weather Bureau and its relation to public interests".

Mr. J. F. Voorhees, of the Knoxville, Tenn., office, October 10, 1907, before the Farragut School, Concord, Tenn., on "How forecasts are made and distributed".

Mr. E. C. Vose, November 15, 1907, before the physical geography class of the Concord, N. H., High School, on "The work and usefulness of the Weather Bureau".

Classes from universities, colleges, schools, and academies have visited Weather Bureau offices to study the instruments and equipment and receive informal instruction, as reported from the following stations:

Albany, N. Y., June 8, 1907, the physical geography class from the La Salle Institute of Troy; also November 14, 1907, a class from the Teachers' Training School of Albany; also November 23, 1907, the physical geography class from the Union School; Rhinebeck, N. Y.

Baker City, Oreg., October 30, 1907, the class in physical geography from the local high school.

Dubuque, Iowa, October 18, 1907, the sixth grade pupils of the Prescott School; also October 25, 1907, the sixth and seventh grade pupils of the Jackson School.

Duluth, Minn., July 23, 1907, a class from the Superior, Wis., State Normal School; also July 25, 1907, a class from the Duluth State Normal School.

Huron, S. Dak., July 25, 1907, a class from the summer school of Huron College.

Los Angeles, Cal., October 15, 16, and 30, 1907, the physical geography class of the Hollywood, Cal., high school, in three sections.

Philadelphia, Pa., March 14 and 16, 1907, classes from the Pennsylvania State University.

Salt Lake City, Utah, September 16, 1907, a class from Lafayette school.

Seattle, Wash., November 14, 1906, a class in physical geography from Ballard High School; January 11, 1907, a class in physical geography from the Franklin High School; April 19 and 24, classes in physical geography, and April 30 a class in elementary meteorology from the Seattle High School.

Syracuse, N. Y., July 19, 1907, the class in physical geography from the summer school of Syracuse University.

A UNIVERSAL SEISMOGRAPH FOR HORIZONTAL MOTION AND NOTES ON THE REQUIREMENTS THAT MUST BE SATISFIED.[1]

By C. F. MARVIN, Professor of Meteorology.

If we try to analyze and represent graphically the movements of the ground, such as result from seismic activity of different kinds and under different conditions, we find that we require several different diagrams, something like those shown in fig. 1.

At 1 are represented the minute motions of the ground, of small magnitude and short duration, such as might be produced by the passage of a heavy car or train; this might even represent a slight shock from a nearby local earthquake, of sufficient intensity to attract the attention of a few people, one that would be recorded by a seismograph of high magnification, as little more than a mere thickening of the line of the recording stylus or photographic trace. The short transverse dashes along the line are intended to mark the minutes of time, and the same time scale is used in the succeeding diagrams.

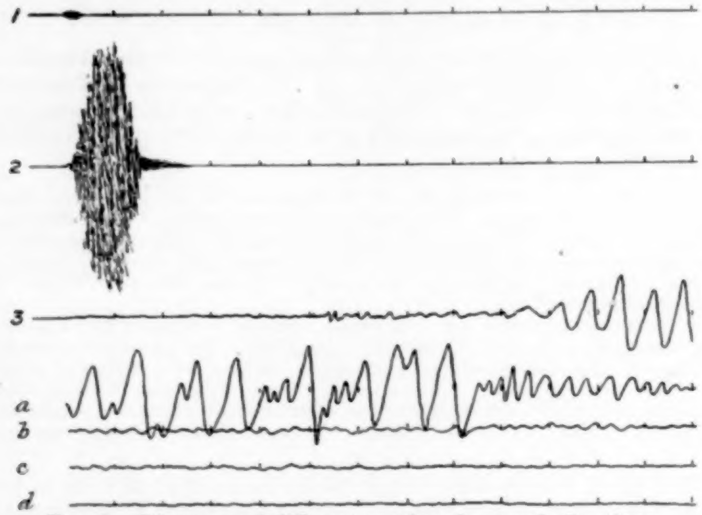

FIG. 1.—Diagrams of different species of ground vibrations.

At 2 we attempt to show, in relative characteristics, a destructive earthquake—such for example, as the earthquake in California in 1906. The time scale is too short to give more than a very general idea of the motion. A multitude of wave vibrations of short period and of great amplitude, as compared with those in 1, are crowded into a short period of time. Practically no details can be made out from such a record as this.

Finally at 3, with continuations of the record at *a*, *b*, *c*, and *d*, for lack of adequate length in a single line, we show the kind of record that will be obtained at a distance of 1000 miles or more from the origin of any great disturbance. As already stated, the time scales are the same thruout the several records, and the amplitudes may be taken to be half size, at least for the larger waves. The smallest tremors are of very great importance in seismic records, and these are greatly exaggerated in the diagrams simply to make them apparent under the scale adopted in the figure.

The three diagrams thus described represent what we may regard as the three limiting classes of shocks. It is plain that one class merges imperceptibly into the other in proportion to the intensity of the disturbance and the distance from the origin at which the record is made. Such diagrams as these may be regarded as representative of one of the two components of horizontal motion, whereas a third set is necessary for the vertical motion, and, in some cases, there may be tilting and twisting motions, all of which require careful consideration.

The problem presented to the instrumental seismologist is to devise and design an instrument or instruments that will record these several degrees of motions in a satisfactory manner. It would be of great interest, at this point, to describe the more important seismographs now in extensive use to meet this demand. To do so, however, even in the briefest manner, would require much more time and space than are available, and it seems best to pass at once to the description of the new forms, recognizing that the present work marks, perhaps, only a step in the evolution and development of the seismograph toward which so much has been already contributed by Zoellner, Ewing, Milne, Gray, Vicentini, von Rebeur-Paschwitz, Omori, Wiechert, Galitzin, and many others.

It may fairly be said that at the present time none of the existing instruments are adapted to register all kinds of earthquake motion. If we wish to record microseismic motions we must get one sort of instrument. A different instrument is

[1] The substance of this paper was presented at the Chicago meeting of the American Association for the Advancement of Science, December 31, 1907.

required for the satisfactory registration of large, distant disturbances. Still a third type of instrument is required for damaging or destructive shocks, and the existing instruments of the first two types, if not completely wrecked when subjected to destructive shocks, at least are seriously disordered, in most cases, and their records falsified and interrupted. If one sets out to equip a seismological observatory, he finds himself obliged to install a large number of instruments. Not only must these be of different types, adapted to the different degrees of intensity and character of earthquake motion, but, in many cases at least, two instruments of each type are necessary, since we have two components of horizontal motion to register, and the horizontal pendulum type of instrument can record only one component of motion. Mention has already been made of the vertical component of motion. Very few instruments are available for recording this, and the measurement and registration of the vertical motion involves exceptional difficulties, and must be treated in a class by itself. Our attention at present is directed exclusively to instruments for the registration of horizontal motion. Those familiar with the subject generally recognize that seismographs, with few exceptions, are influenced by more than one kind of motion. Seismographs for horizontal motion are all influenced by changes in the direction of the vertical and by the tilting of the ground, as well as by vibratory horizontal displacements, so that we can not certainly tell just how a given record should be interpreted.

Having all these matters in mind, I have undertaken to design a seismograph for horizontal motion that should satisfy all the reasonable demands to a much greater degree than any of the instruments now available. The results obtained with the most perfect instruments are, at the best, somewhat uncertain in details, and, recognizing this, my chief object has been the development of a type of instrument that shall satisfy all reasonable requirements for general observatory work, and from which entirely reliable records can be obtained by the average observer. The special student of any problem is always able to refine his instruments and methods so as to attain results of the highest possible order.

A seismograph consists essentially of three separate and distinct parts, viz:

I. The steady mass, so-called, whose function it is simply to remain stationary during the earthquake.

II. The connecting and transmitting mechanisms between the steady mass and the adjacent ground, whose function it is to transmit and, if necessary, more or less to magnify and to inscribe the motions of the ground; and, finally—

III. The recorder, consisting simply of clock movements, drums, paper, etc., upon which the record is actually inscribed.

There is still a fourth part, which, while often missing and not entirely essential, is nevertheless a valuable adjunct in many high-grade seismographs, namely:

IV. Damping devices. These serve the purpose of limiting and controlling the motions that the steady mass may sometimes acquire.

In the presentation which follows we shall take up these parts in order and shall first discuss in each case the general requirements that must be met and more or less perfectly satisfied, then describe the devices and apparatus designed by me to meet these requirements.

I.—THE STEADY MASS.

General requirements.—In the first place, the whole seismograph, especially the steady mass, must be absolutely earthquake proof when solidly installed and subjected to seismic vibrations of the severest order. Of course no seismograph can measure and record the great displacements of several feet that may occur, for example, in the immediate proximity of a line of faulting or where soft, alluvial, deposits of soil are bodily shifted by large vibrations; but we may reasonably demand that an acceptable seismograph be able to ride thru true vibratory motion of the most severe degree, and to do so without the least disorder or derangement of its functions; in fact, it must faithfully record *all* this motion. At first sight, it may seem almost impossible to construct an instrument that will record truthfully the violent surgings and vibrations of the ground during a great destructive earthquake that lays a whole city in ruins in a few seconds; nevertheless, it is actually easier to construct an instrument for this purpose than it is to produce one that will record equally well the great unfelt vibrations that are propagated to great distances from the origin of a violent disturbance.

It is hardly practicable to enumerate all the requirements that we have aimed to satisfy in this new instrument, but we have had a primary regard for all such questions as facility of manufacture and installation; immunity from disturbing influences of the immediate environment, such as temperature, surface tilting, etc.; convenience of manipulation, adjustment, maintenance, and general infallibility of registration, etc.; and finally, the question of cost has received due consideration. In respect to this I may say that a long experience with many classes of instruments has thoroly convinced me that the man who rejects a carefully designed and manufactured piece of apparatus because it costs rather more than something cheap, which may, perhaps, seem good enough, is doomed to disappointment. The best we can do is pretty certain to fail sooner or later, and the failures always come at some critical time when failure is most disastrous. Cheap apparatus is frequently replaced at a later period by something better, thus greatly enhancing the total outlay with less satisfactory results.

Assuming that the reader is familiar with the general elements of seismic apparatus, I may say that the steady mass is, in a certain sense, the basis of the whole instrument. It is impracticable to discuss here the kinetic conditions that must be satisfied in the design of this part of the apparatus, but I can not emphasize too strongly the primary necessity that the steady mass be *free to remain at rest* thruout *all* portions of *any* earthquake. If we examine many of the existing instruments we find it impossible for the steady mass to remain at rest, except only for motions of very small amplitude. In most of the photographic recorders—of the horizontal-pendulum type, for example—the steady mass is carried on a very short strut, or moment arm. This construction not only introduces large angular motions of the strut as a result of moderate relative movements of the ground and steady mass; but even with slight deflections the pendulum is largely influenced by motion at right angles to its axis; that is to say, the instrument records movements which it is not supposed to register.

Again, probably all the instruments now employed in the registration of microseismic motion, if not open to the criticism just made, are, nevertheless, so trammeled with stops, or bumpers, that the steady mass is free to remain at rest only for very small displacements of the ground. This is especially necessary in instruments with mechanical registration, and arises from the fact that the delicate mechanisms employed to magnify the motions from one hundred to two hundred or more times form a delicate system of linkages which in reality can operate only over a very limited range, and are likely to be wrecked or seriously deranged by motions beyond this range. In all these instruments, therefore, the steady mass, during the stronger motions of the ground, is bumped into and buffeted here and there by the stops or buffers on the apparatus, and the records made at such a time are, of course, rendered valueless. It is a very unsatisfactory excuse to make that instruments of this class are not designed to record the larger movements of an earthquake.

In order that the steady mass may be as free as possible to remain at rest for all kinds of earthquake motion it must be mounted upon a relatively long strut, or moment arm, or sup-

port. By "long" in this connection, I mean a distance of two or three feet, at the least. Supports of much greater length may easily be employed and possess very great advantages in other respects, which will be discust later.

Two types of steady mass, briefly described.[2]—It seems advisable, at this point, briefly to describe two types of steady mass that seem best adapted to meet all the possible requirements. This will give the reader a mental picture that will be of great assistance in the further presentation of the general requirements. These types are shown diagrammatically in figs. 2 and 3.

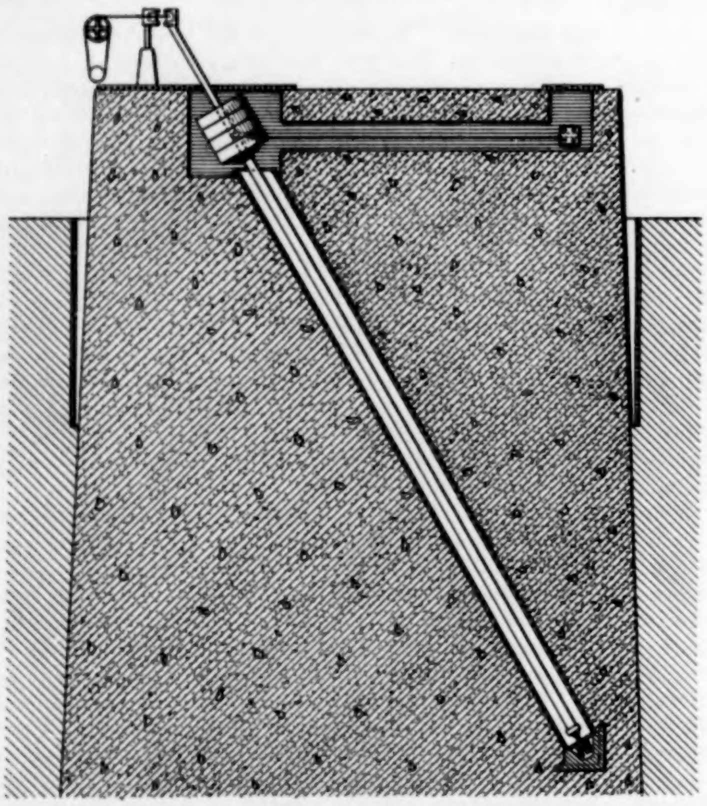

FIG. 2.—Inverted horizontal pendulum seismograph, Marvin system.

The first form is simply an inverted horizontal pendulum. The object especially sought in the adoption of this construction is to secure relatively large dimensions and, at the same time, to escape, as far as possible, disturbing influences due to temperature and lack of solidity and rigidity. This type of pendulum is peculiarly suited to what we may call absolute measurements of large vibrations, because the highest accuracy of measurement becomes possible owing to the very long period that it seems practicable to realize in this construction. As the instrument is chiefly relied upon for large motions only a low scale of magnification will be utilized.

The second type of steady mass is better adapted to the ordinary registration of earthquakes at numerous stations and for general seismological work. It consists of an inverted pendulum, that is, a heavy mass on the top end of a strut supported at its bottom end on a suitable form of frictionless pivot. The mass at the top end is prevented from wobbling about by the reaction of a suitable spring, *S*, which causes it to stand quite erect, and, when disturbed, to oscillate freely about a definite position of rest. Any reasonable range of motion may be provided for.

Period of the steady mass.—Referring particularly to the last-described arrangement, we now have mentally before us a steady mass, which, so far as its mountings and immediate en-

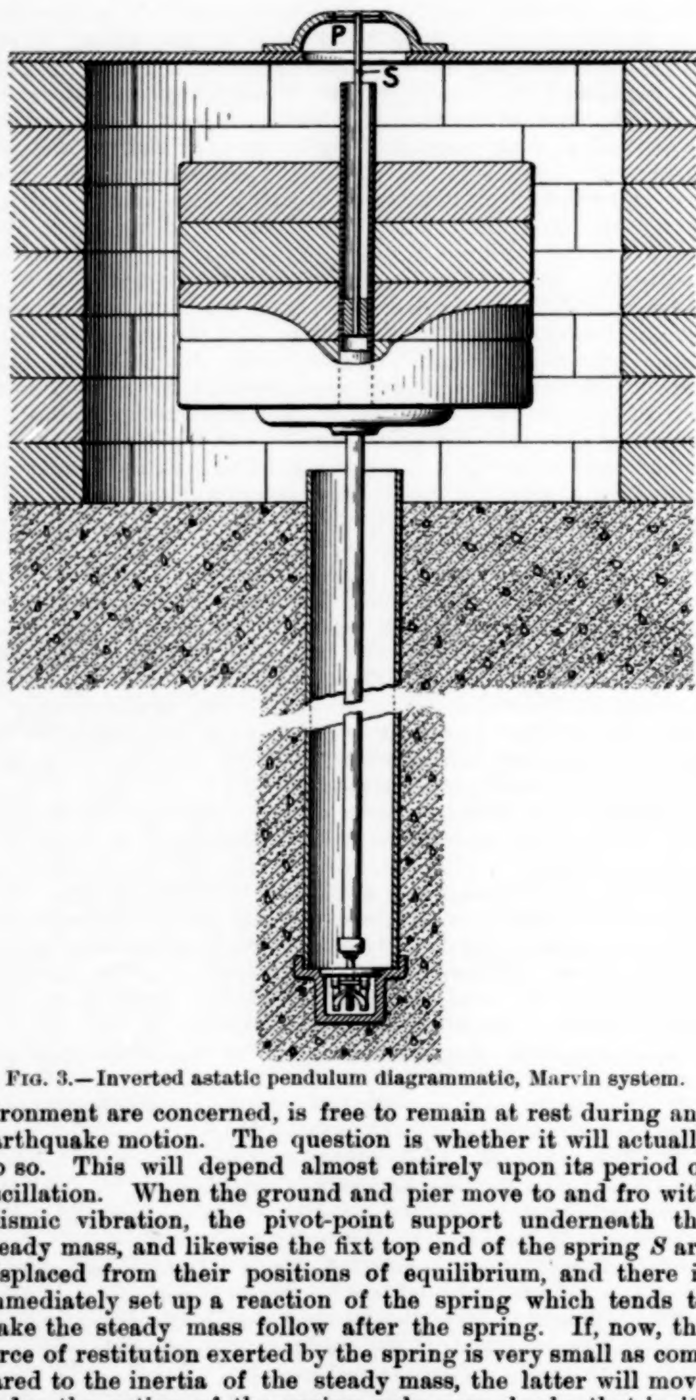

FIG. 3.—Inverted astatic pendulum diagrammatic, Marvin system.

vironment are concerned, is free to remain at rest during any earthquake motion. The question is whether it will actually do so. This will depend almost entirely upon its period of oscillation. When the ground and pier move to and fro with seismic vibration, the pivot-point support underneath the steady mass, and likewise the fixt top end of the spring *S* are displaced from their positions of equilibrium, and there is immediately set up a reaction of the spring which tends to make the steady mass follow after the spring. If, now, the force of restitution exerted by the spring is very small as compared to the inertia of the steady mass, the latter will move under the action of the spring only very slowly, that is, its free period of oscillation will be very long. If now, at the same time the seismic vibrations of the ground and pier are relatively rapid, it is very plain that the steady mass can move only very slightly under the influence of the spring and the vibrations of its pivot support before the directions of the motion of the ground and the influence of the spring are reversed. In other words, the steady mass remains very nearly at rest only when the period of the ground vibrations is very short as compared with that of the steady mass. This requirement is easily satisfied in the case of damaging or destructive shocks, as in such cases the periods of the motions to be dealt with are mostly only one or two seconds, or even fractions of a second; and it is very easy to get a period of fifteen or twenty seconds for the steady mass—that is ten to fifteen times as long as the periods of the disturbance. For this reason it is much easier to record accu-

[2] A detailed description of the two types of steady mass is given below.

rately the ground motions in destructive earthquakes than to record the large, slow motions that are propagated to great distances from an origin. In these latter cases the ground vibration may often have a period of from ten to thirty seconds, or even longer, which coincides so nearly with the natural period of the steady mass that the latter at once follows, systematically, all the disturbing vibrations. The steady mass in fact is set into violent oscillation and its record falsified. To avoid this difficulty we should lengthen the period of the steady mass to, say, two hundred or three hundred seconds. This, however, introduces new difficulties, and steady masses with periods of more than sixty to ninety seconds are not yet in successful use.

While the steady mass, for the reasons just explained, may sometimes fail to remain at rest, yet the earthquake motion is so complex and the period changes in such an irregular manner that the records are only partially impaired. To overcome this difficulty resort must be had to what is called damping, which will be more fully discust under Section IV.

Weight or inertia of the steady mass.—The mass of matter which must be concentrated in the steady mass depends on the period of the pendulum, the resistance to be overcome at the pivots or other connections with the pendulum, and the work involved in producing the desired record. In the latest photographic recorders made by Bosch a mass of 100 grams entirely suffices, and the motions are controlled by a simple air-damping device.

A vastly greater mass is necessary if mechanical registration is employed, and in this case the amount required depends upon the magnification and the method of registration. With mechanical recorders magnifying 200 times Wiechert employs a steady mass weighing just about one ton (2,200 pounds). Probably there is no method of mechanical registration so delicate and so nearly frictionless as that of writing by means of a very light stylus upon the smoked surface of glass or paper. Exceedingly fine lines can be made and the minutest details are perfectly reproduced in the record. If the period is from twenty to thirty seconds a steady mass of twenty to fifty pounds is necessary to inscribe a record of this kind with a magnification of ten to twenty times and without damping. Damping could not be used on such a pendulum unless the period was reduced below twenty seconds, as the unavoidable friction would itself damp the pendulum about as much as would be allowable.

I have made quite an extensive investigation into the force required to inscribe smoked paper records, and have ascertained about the limit beyond which we can not go in practical work. The resistance is primarily proportional to the pressure exerted by the stylus and depends very little upon the thickness of the soot coating. If the soot coating is too heavy the stylus will not inscribe a deep line, but will ride partly on top of the soot; while a thinner coating will be wholly removed with about the same resistance. One must, therefore, adopt a sort of standard thickness of soot. In my own case, I require a coating sufficiently dense to yield a good strong photographic reproduction of any records I may obtain. Such a coating may be rather thin and perceptibly translucent, after varnishing, when held up to the light.

The stylus required to write a reasonably satisfactory record in these cases must exert a pressure at its writing point of not less than one or one and two-tenths milligrams. The force required to move such a stylus sideways varies considerably, as may easily be understood, but it is very close to one milligram, possibly a little less.

I have measured the pressure and force required over a wide range of conditions, and have been surprised to find that the force required to push the stylus is only a little less than the pressure exerted at its point; that is, from 0.8 to 0.9 of the pressure. This signifies a very high coefficient of friction, but the action of the stylus in plowing away the soot is not quite analogous to ordinary cases of friction.

I have published in the Monthly Weather Review for May, 1906,[3] methods of further reducing the friction by the influence of minute vibrations, which keep the point of the stylus in a continual state of tremor. By this method the pressure of the stylus can be reduced to from 0.7 to 0.8 milligram, and the resulting line, owing to the minute tremors, will be better than the line produced by the heavier stylus and with distinctly less friction; but long experience shows it is difficult to maintain the vibrations at just the right period and intensity. Little changes come in at times, and, in some cases, the action of the vibration influences the pendulum itself and induces wave motions that vitiate the record.

As the friction at the stylus is generally of far greater influence in damping the pendulum than the unavoidable friction at the pivots, we may form an idea of the mass of matter required to overcome this resistance under given conditions.

Thus far we have considered chiefly the resistance to be overcome. The source of power to overcome the resistance is, in every case, the *force of restitution* of the steady mass. This force of restitution is primarily a function of the period of the pendulum. The period, therefore, becomes of great importance in this connection. If the pendulum is displaced a small amount from its position of rest, and if the friction at the stylus and at other points is greater than the force of restitution corresponding to the given amount of displacement, then the pendulum will be unable to return to its position of rest. This state of affairs can easily be realized by simple experiments with a seismograph with mechanical registration.

The force of restitution in any given case is

$$f = W \sin i,$$

where W is the mass and i the angle of deflection. We may write instead

$$f = W \frac{4\,d}{lT^2},$$

in which d is the displacement at center of percussion, l is the length of the seconds pendulum, and T is the period of the steady mass. If now x is the displacement on the record sheet, and n is the multiplying factor, then $d = \frac{x}{n}$. If f_s is the force of restitution as exerted at the point of stylus, then $f_s = \frac{f}{n}$, whence,

$$f_s = W \frac{4\,x}{lT^2 n^2}.$$

For seismographs with mechanical registration on smoked paper, the weight of the steady mass should, in general, be great enough to give f_s a value rather greater than one milligram, when x is one millimeter.

The writer strongly advocates the use of heavy steady masses and large dimensions for seismic instruments. The little, delicate photographic recorders with steady masses of a few hundred grams and the possibility of motion greatly limited are not suited to real earthquake registration. Their chief utility is to record the slow, diurnal and secular tilting motions of the crust of the earth, resulting from tidal stresses and other causes.

Sensitive masses.—In all that precedes great stress is laid upon the necessity that the steady mass be perfectly free to remain at rest, or that if it move at all it do so under some kind of damping control so that its motion may be determinate. This is necessary if we wish to *measure* the amount of earthquake motion. If, however, we wish to ascertain simply that earthquake motion has occurred the best device is not a "steady mass" that shall remain at rest, but what we may call

[3] Vol. XXXIV, p. 214.

a "sensitive mass"; that is, a mass very free to oscillate and with its period so chosen that it synchronizes closely with the kind of earth vibrations it is designed to show. In cases of this kind, exceedingly minute tremors of the ground, if they persist for a few seconds, may suffice to set the "sensitive mass" in relatively very great motion.

Instruments in which this principle is employed have, however, only a rather limited utility.

The two types of steady mass designed by me will now be described in detail.

The inverted horizontal pendulum.—The writer proposes this arrangement of the steady mass in order to realize the longest possible period of free oscillation. For this purpose the dimensions of the pendulum must be as large as possible. But if we give the pendulum large dimensions and build it on the top of the pier, we introduce two new difficulties which largely defeat the objects in view; that is, we are likely to lose rigidity and solidity, which are of the greatest importance, and to introduce uncontrollable temperature differences and other influences which are proportionately exaggerated with the larger dimensions. We therefore build the pendulum as much as possible below ground, and not only do we secure solidity and stability, otherwise unattainable, but the troubles from temperature and other atmospheric influences must be very largely reduced.

A pendulum of this character is peculiarly adapted to register large slow vibrations that form part of the wave motions induced by distant earthquakes. Such an instrument requires only small magnification, and in many particulars it is very easily constructed and maintained. Details of construction will be readily understood from the accompanying figures and description of the second type of pendulum. Some features of the theory of the instrument and limitations upon the development are given below.

The period of vibration of a horizontal pendulum is derived from an equation of this form:

$$T=\frac{2\pi}{\sqrt{g}}\sqrt{\frac{lh}{a}}$$

where l and h are, respectively, the horizontal and vertical arms of the pendulum, while a is a small quantity measuring the slight inclination it is always necessary to give the vertical arm.

It is plain that the value of T is greater the greater we make the product lh and the smaller we make a. The quantity a can not, in general, be made smaller than certain minimum limits. In any case we make a just as small as practicable. For great periods the product lh must be as great as practicable.

Omori, in Japan, employs horizontal pendulums of the greatest periods of any at present in use, sixty seconds or more. The product lh in these cases is, I believe, about 2.65 (meters by meters). By adopting the proposed construction, it is entirely practicable, I think, to increase this product up to six or more, and thus realize the longest practicable periods. The new difficulties introduced by this procedure arise from astronomical and meteorological causes. A long-period pendulum is exceedingly sensitive to variations in the direction of gravitation, and to slow tiltings of the ground due to obscure meteorological and other influences. Only recently an account of a highly important work has been published by O. Hecker[4] upon the influences of the sun and moon upon the horizontal pendulum and the deformation of the crust of the earth. According to the results obtained by Hecker, there is a definite daily variation of a horizontal pendulum, even when sunk to a depth of 25 meters below the surface, which, in extreme cases, may attain a maximum value of 0.05 second. This influence causes the recording stylus of a highly sensitive pendulum to wander slowly from one side of the record sheet to the other, and thus causes difficulties not otherwise encountered in more stable systems. The tidal influences, moreover, are complicated by large and slow tiltings of the ground, due to various causes. All these details require careful consideration in any effort that may be made to realize a very long period for the steady mass. The tidal and tilting influences mark the limits beyond which we can not go in the development of this branch of the work.

The type of steady mass which I am now considering, that is, the inverted horizontal pendulum, will, I believe, enable us to realize the longest possible period of oscillation and still retain a sufficient degree of stability for practical recording. If experience proves that a period of two hundred seconds or more is practicable, then any wave motions that generally occur will be almost perfectly recorded by it; that is to say, such a steady mass will remain almost perfectly at rest, and the indications of such an instrument should constitute the nearest approach we yet have to an absolute measure of the earthquake motion. These conclusions are based on the assumptions that the movements of the ground are literally movements of translation. If the motions are really tiltings of the surface and not translations, then the indications of the long-period steady mass will be very greatly exaggerated and will require to be interpreted upon an entirely different basis than if the motions are translations.

Simple inverted pendulum.—This arrangement of the steady mass seems better adapted than any other for the registration of all kinds of horizontal motions.

Fig. 4 shows in sectional elevation the large instrument with which all the experiments leading to the results set forth in this paper have been carried out.

In this case also the steady mass is built *within* the pier, and is practically wholly inclosed by the latter. When the pit is being excavated for the pier, a post hole is dug beyond for a depth of several feet, and a piece of iron pipe, closed at the bottom, is set up perfectly vertical on a good, strong, footing of concrete. The pier is then built up around the pipe as indicated, and the top covered over by a suitable iron plate which forms the base plate for all the recording apparatus, thus realizing the maximum of solidity, compactness, and accessibility. The strut for the steady mass is made of ordinary iron pipe (steam or water pipe), and terminates at the lower end in a type of universal pivot of ribbon-steel construction. One of these adapted to sustain safely a steady mass of over 2,000 pounds is shown in fig. 5. The iron pipe built in the pier is of such construction that the steady mass and strut with its suspension can be inserted and removed from the pier whenever desired, without the least derangement of the suspension.

This arrangement constitutes, of course, an inverted pendulum, and is in unstable equilibrium. It is rendered astatic by the reaction of a cylindrical steel spring rod S and plate P, arranged exactly as shown in fig. 3.

Wiechert has used very successfully a short, inverted pendulum, but the method employed by him to render the pendulum astatic seems less convenient to arrange and manipulate than the one here shown and does not permit large ranges of motion; moreover I believe it is not so technically correct in its mechanical action.

The lower end of the spring S is intended to be fixt at the center of percussion of the whole steady mass. Under these circumstances its reaction upon the suspended mass coincides as exactly as may be desired with that of the force of gravity, which in this case is to be wholly neutralized; and when the reaction of the spring slightly exceeds the component of gravity the whole mass oscillates more or less slowly upon its pivot in proportion to the excess of the reaction of the spring over the component of gravity. It is necessary, of course, to eliminate friction to the greatest possible degree. The ribbon-steel

[4] Beobachtungen an Horizontalpendeln über die Deformation des Erdkörpers unter dem einfluss von Sonne und Mond. Von O. Hecker. Berlin, 1907.

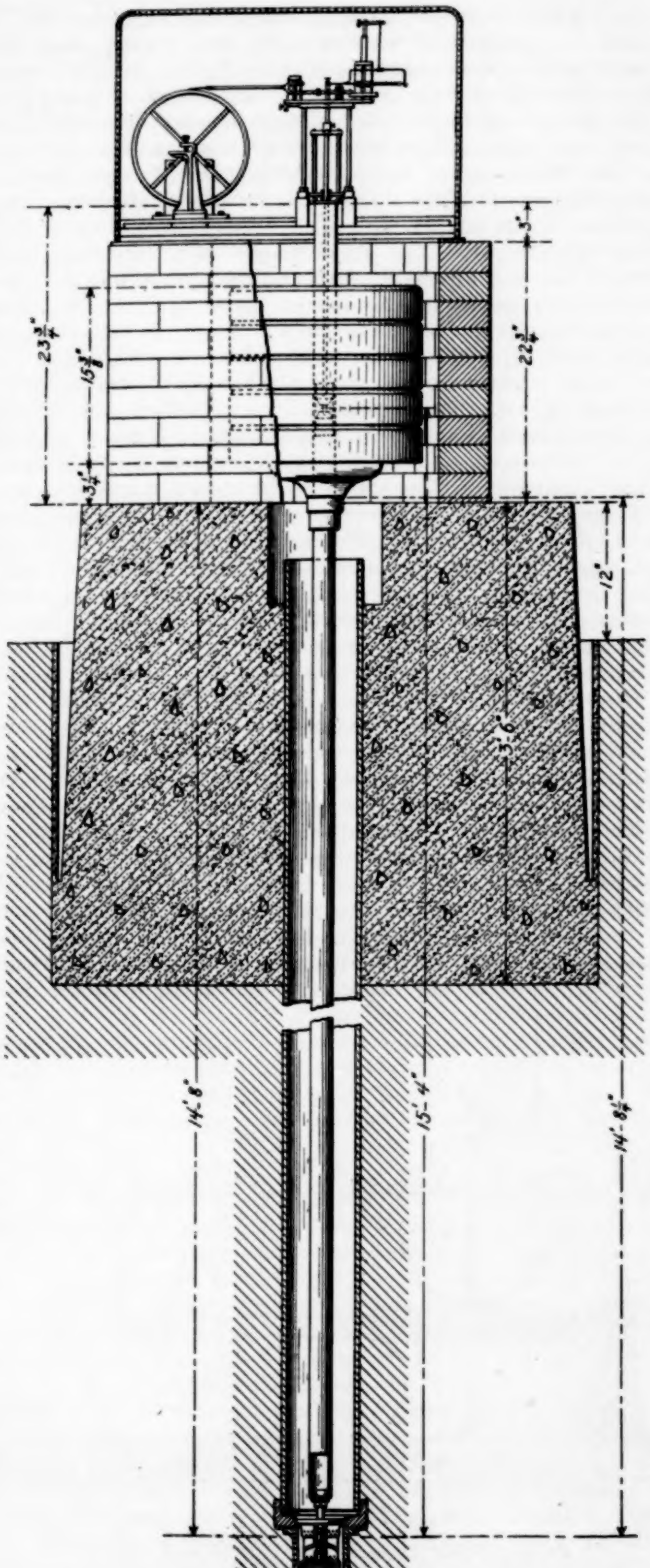

FIG. 4.—Inverted astatic pendulum seismograph, Marvin system.

suspension realizes this in a highly satisfactory manner when great weights are to be supported. It is equally important that the spring *S* be held at both ends (the top and bottom) in the most approved fashion. At the bottom end the spring is fitted on a slight taper and driven into a massive metal plug. At the top the spring rod seizes, by means of a screw clamp, a flat, tempered-steel disk which, in turn, is securely clamped around its periphery to the top of the pier. Very simple and exceedingly convenient means are provided for centering the steady mass vertically above its pivots. The spring *S* and plate *P* must be of the best spring-tempered steel, and a thoro investigation of these has shown most remarkably perfect elastic properties. To realize the benefits of these properties, however, the pieces of steel must be grasped in the most perfect manner possible.

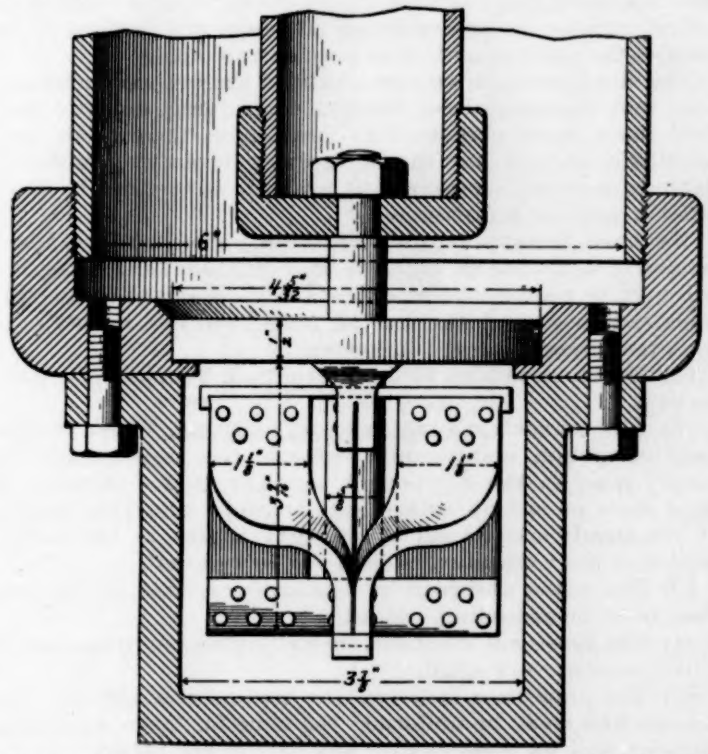

FIG. 5.—Universal pivot, or gimbal, of ribbon-steel construction, Marvin system.

Without any exception, so far as I know, seismographs are constructed to be installed largely above ground, that is, above the floor of the room occupied.

The plan shown here, of building the mountings of the steady mass *in* the pier, rather than *on top of it*, secures, first, a degree of solidity and invariability that are unattainable in the ordinary construction; and, second, the elimination of the unequal changes of temperature in different parts of the apparatus, which cause serious wanderings and driftings of the zero position of exposed seismographs. To exclude dust, insects, etc., and avoid influence of air currents, the exposed mechanisms on the top of the pier can be easily inclosed by a small, close-fitting cover of glass or other material.

A steady mass of this design and arrangement has, as regards earthquake vibrations, almost unlimited freedom of motion in the horizontal plane. It is simply a question as to how much motion we may desire to record on some extreme occasions. A double amplitude of 3 inches has seemed adequate from the information available to the writer, but greater motion can easily be provided for, if necessary.

II. CONNECTION BETWEEN STEADY MASS AND RECORDER.

General requirements.—In all that precedes we have shown how we may arrange and construct a steady mass that is practically earthquake proof and free to remain at rest. The next important step is to devise means whereby we may take off the two horizontal components of motion between the ground and the steady mass, and cause the same to be properly inscribed upon the record. Of course during an earthquake it is chiefly the ground, not the steady mass, that moves, but

as we look at the instrument it seems as if the steady mass itself moves, and that form of the expression is simpler and may be used occasionally even tho inexact.

I have already indicated, partly at least, that all existing forms of seismographs fail to meet the requirements of a universal instrument, either because the steady mass is on too short a strut, or, more particularly, because the recording levers and connecting mechanisms can perform their functions under only a very limited range of motions, and generally they are saved from serious injury during strong earthquake action only by the interposition of stops and buffers which restrict the relative motion to very narrow limits.

The steady mass in an instrument of the ordinary construction, with mechanical registration magnifying, say, two hundred times, is not permitted to move more than a few hundredths of an inch, and the multiplying levers are constantly liable to serious disorders that are well understood by those familiar with such instruments.

We have tentatively adopted three inches, or 75 millimeters, as the maximum probable motion that the seismograph will ever be required to record. Any mechanisms connecting the steady mass and the ground must therefore satisfy some such requirements as the following:

(1) Maximum motion to be transmitted, 3 inches (75 millimeters).

(2) The connection must take off only one linear component of motion, and permit perfectly free movement of the steady mass in the component at right angles thereto. It must show no motion, or the least possible, when the motion of the steady mass is strictly at right angles to the component that the connection is designed to transmit.

(3) The power absorbed in transmission, that is, the friction, must be exceedingly small.

(4) The looseness, or shake, or lost motion, in transmission must be *nil* or very small.

(5) The proportion between the motion received and that transmitted must be uniformly the same for large and small motions, and for motions over any part of the range.

(6) Conditions of simplicity, accessibility, adjustability and general convenience of manipulation and maintenance must be satisfied as far as practicable.

Description of high magnification transmission.—Having discarded numerous devices and arrangements I have finally developed the spring-bow and wheel transmission shown in plan and elevation in fig. 6; this seems to meet nearly all the requirements. The topmost extremity of the steady mass terminates in an adjustable pin, *P*. At the top end of *P* two hardened-steel cups, like those shown at *C*, are inserted at right angles to each other, with the one just above the other.

It may be convenient, in some cases, to have the cups *C* adjustable, that is, to screw in and out. A piece of steel music wire, *S*, 0.044 inch in diameter, is sharpened to a needle-like point where it rests in the cup *C* and is bent in the form shown. The hooks *h*, *h'* are formed of any quite fine wire, which is coiled in the manner indicated, and slipt over *S*. The hooks must be fastened, if not coiled tight enough to hold otherwise. *W* is a very light skeleton wheel, mounted on a very free-moving, pivot-pointed axis of the well-known construction, as shown. The rim of the wheel is provided with three grooves, as indicated. While these grooves are really very small, they are relatively very deep compared with the fine silk thread which is run around the grooves. The figure shows an enlarged cross-section of the rim, with dimensions of the grooves marked in units of .001 of an inch. At one side of the wheel a hole is made thru the rim at the bottom of each groove. A piece of ordinary silk sewing thread of the proper length (which can easily be determined) is taken, and its free ends past thru the holes in the outside grooves, one end in each hole; the free ends are then securely knotted together. A loop of the thread is then pulled thru the hole in the bottom of the central groove, leaving the knot on the inside of the rim. The attachment of the thread to the spring-bow by means of the hooks at *h''* and *h'''* is a very simple matter, easily understood. The spring-bow is suspended in a free-moving fashion by means of a thread, as indicated. Finally, the link-suspended, small weight *wt* serves

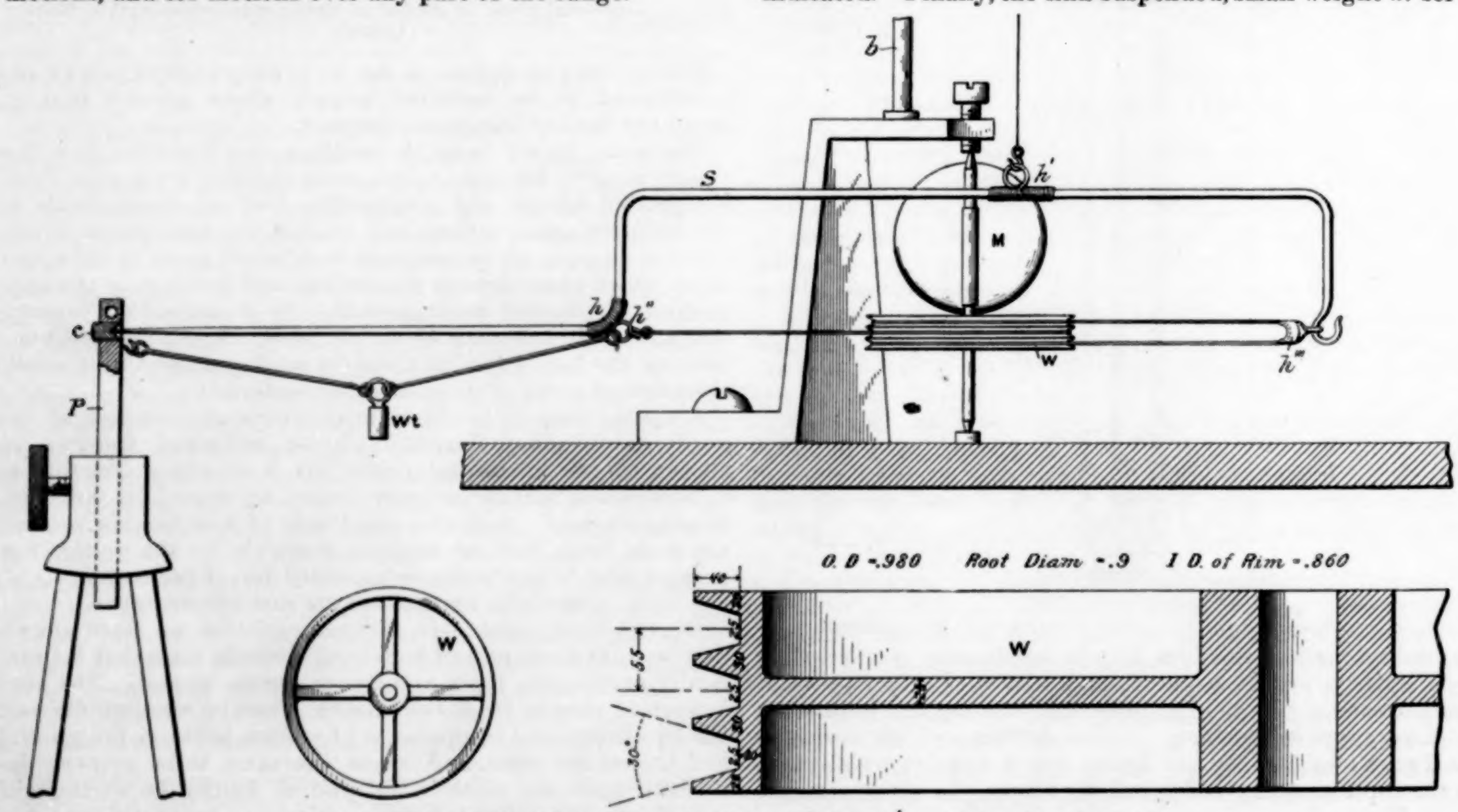

FIG. 6.—Plan and elevation of the spring-bow and wheel transmission, Marvin system.

to keep the point of the spring S in the cup C with a gentle pressure.

The action of this system for taking off the motion is exceedingly smooth and devoid of shake, lost motion, and friction. The arrangement of the double thread in the three grooves secures a perfectly balanced system of internal forces. The action of the spring-bow takes up symmetrically any slight variations of the threads with moisture, etc.; and where the threads parallel each other they are free to slip over the hooks h'' and h''', thus equalizing, approximately, the tension in the two branches. The wheel W, if one inch in diameter, provides for 3.14 inches of motion, and more than one turn of the thread on the wheel is permissible. The distance of the wheel W from P can easily be made sufficiently great to satisfy fully the requirements of (2).

By the aid of this arrangement we accomplish the first step in the process of transmitting the motion of the steady mass to the record. We simply transform one component of the motion into approximately one turn of the wheel W and its staff. It remains now to transfer this motion with the necessary magnification to the record sheet.

Fig. 7 shows a system of levers for this purpose, with a magnification of 120 times. The writer has used this arrangement very successfully for several months past, and it seems to meet all the requirements herein set forth. The distinguishing features of this system are the means provided by which the motions of the levers stop when these reach a certain extreme position, whereas the motion of the wheel W and its connection with the steady mass are in no wise limited by the levers. This is accomplished by exactly the same devices that are employed in the lever-escapement of all ordinary watches, and when the levers are properly constructed there is little to prevent their action from being just as certain and reliable as is demonstrated to be possible in the millions of watches and clocks in common use. A pin, p, on the wheel W' engages a forked opening in the lever l. Underneath the fork of the lever a small pin enters a notch or opening in the flat rim of W'. When the motion of the wheel W' carries the pin p out of the fork in the lever l, the pin below the fork has likewise past out of the notch in the rim, and the lever is prevented by the rim from returning until the return movement of the wheel accomplishes a re-engagement of the pin p and fork. The end of the lever l, opposite the fork, is provided with a delicately pivoted pin, p', which in turn, engages a fork in the short end of the stylus lever L, as seen. Inasmuch as the stylus lever can not sweep over a much wider angle than that embraced within the width of the record sheet, it is necessary that p' also disengage under conditions of extreme motion with high magnification. This is easily effected by making the fork in the end of L of the shape shown, and providing two small bristle brushes, b, b', to limit the motion of L. The lever can not go beyond the brushes, and it can return only when the pin p' is ready to engage the fork.

While these devices perform their function remarkably well and recorded perfectly the great earthquake of December 30, 1907, yet the writer has recently developed the photographic registration to such a state that he regards it decidedly the most advantageous for all records of high magnification (100 to 200). Mechanical records are best under conditions of moderate magnification, two to twenty or thirty times, for example.

III. THE RECORDER.

General requirements.—No seismograph can claim to possess universality that does not provide for a magnification of at least one hundred times, which is necessary in order that the small microseismic motions may be easily distinguished. On the other hand the larger motions may be very easily recorded with a small magnification of two to five times. We must, therefore, have at least two records with low and high magnifications, respectively.

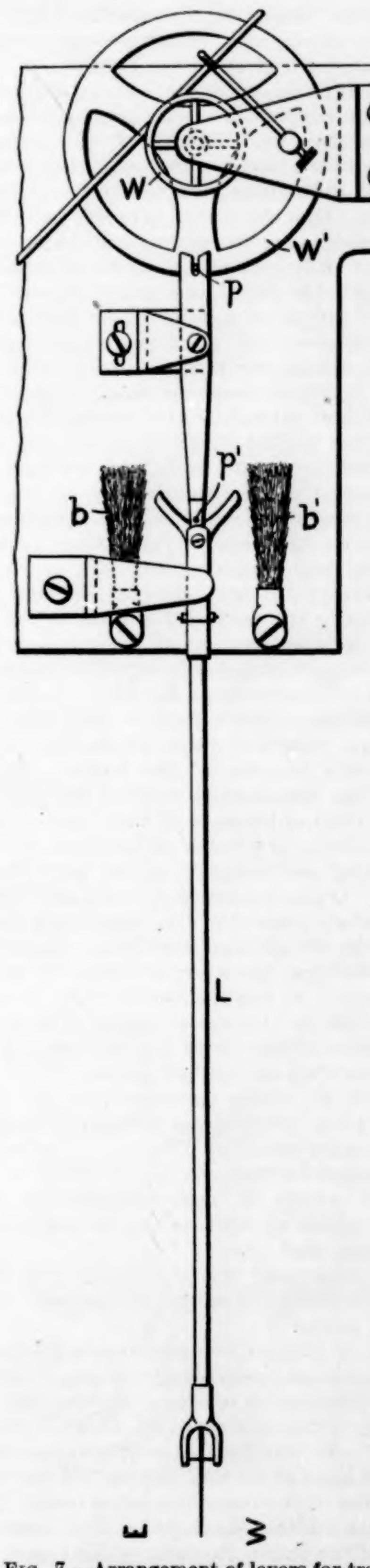

FIG. 7.—Arrangement of levers for transferring motion, Marvin system.

Kind of record.—There are, perhaps, three kinds of records open to choice:

(1) Photographic records.
(2) Records on smoked paper.
(3) Ink records on paper.

The photographic record is, unquestionably, the most elegant and perfect of all, and, under proper arrangements, is available for an almost unlimited range of work. The imponderable pencil of light is, of course, absolutely devoid of friction and imposes no constraint upon the steady mass, whatever the magnification may be. The chief objections to photographic registration are found in the considerations of expense for paper, in some difficulties involved in development of records, and in the fact that the record is invisible until developed.

The smoked-paper records are undoubtedly of the most valuable kind, not only because of their cheapness, but because of the remarkable detail and completeness of the whole result. The chief objection against them lies in the question of the friction, but even this is of no consequence whatever for small magnifications, say ten to twenty times, or less. It is perfectly easy in these cases to employ steady masses of reasonable weight and yet sufficient to render the friction effect unimportant. With higher magnifications, especially of one hundred times and more, and with long periods, the advantages of the smoked-paper records largely vanish, not only because the high magnification requires a steady mass of great weight, but because the multiplying lever system must be compounded, involving several joints and more friction and increased opportunity for lost motion. Finally, there is the difficulty of retaining the perfect freedom of the steady mass while it actuates a lever system of high magnification. All these difficulties vanish completely when we adopt the photographic method of registration for high magnifications and retain the mechanical recorder for low magnifications.

The pen and ink record is quite unavailable for high magnifications, not only because of the fundamental objections given above to the mechanical devices for multiplying the motion, but still further because of the greater friction at the writing point. There are other difficulties of a mechanical nature in providing and maintaining the pens themselves and the ink supply. Quite satisfactory solutions for these difficulties are, however, possible, with magnifications of two to ten times, and the writer has used this system quite extensively. His preference, however, is distinctly in favor of the smoked-paper record, as the danger of losing a record by the stoppage of the ink or otherwise during a destructive earthquake is very much greater with the ink record than in the case of a stylus writing on smoked paper.

In the light of all these considerations, we find ourselves led to the following conclusions, namely, that in a universal seismograph we must provide:

(1) A highly magnified record (one hundred to one hundred and fifty times), which is best realized by photographic processes, which entail no friction and no constraint whatever on the steady mass, and

(2) A slightly magnified record (two to five times, or even full size), of mechanical character, by pen and ink or, preferably, on smoked paper.

Such a system of duplex records from a single steady mass is a perfectly simple and practicable realization of a universal seismograph for horizontal motion. Any seismic vibrations of a reasonable period that are revealed under a magnification of one hundred to one hundred and fifty times, or that do not exceed the 3-inch limit of motion, can hardly fail to be recorded on one or the other of the recorders or on both. If the moving spot of light goes off the sheet, even if it sweeps the entire circumference of the room, no harm is done, and, on the other hand, the pen of the mechanical recorder with small magnification need never go beyond the margins of the sheet. We therefore never fail to get the record in its entirety.

The general arrangement of devices by which all these results are accomplished is shown diagrammatically in fig. 8.

Speed of paper.—Thus far we have said nothing as regards the proper speed of the record sheet. This, however, is very important. What we require here is simply that the waves be drawn out so as to be fairly well separated. On the other hand, too rapid a motion involves a large expenditure of material and labor in maintenance. A speed of 90 centimeters, 35 inches, per hour is a speed commonly used and seems to answer all requirements, except for the case of destructive earthquakes. In such cases the periods of the earth motions are from one-tenth to one-twentieth those in distant earthquakes; hence we must increase the speed of the paper during destructive earthquakes to at least twenty times the ordinary speed.

The limited experience of the writer with damaging or sensible earthquakes does not enable him to decide definitely whether both recorders should be run at a high speed during damaging earthquakes or not. Such considerations as follow indicate a partial answer to this question.

If we take 4 inches as the maximum possible "throw" of the spot of light that can be registered on the photographic record, and assume a magnification of 100, we must have at such times a ground motion of .04 inch. If the period is one-half second, the maximum acceleration is—

$$I = \frac{4\pi^2 a}{t^2} = 6.4 \text{ inches, or } 160 \text{ mm., per sec. per sec.}$$

This result indicates a disturbance of very slight intensity, even tho the highly magnified waves pass clear to the edges of the paper, or beyond, in the photographic record. Of course greater disturbances would be too large to appear on the photographic record under any circumstances. We are, therefore, of the opinion that for damaging shocks there is no necessity for high speed motion on the photographic, or highly magnified, record. The requirements of ordinary observational work are fully met by provision for high speed on the slightly magnified record only. That is to say, whenever there is a fairly strongly-felt earthquake the recording drum for the slightly magnified record must be run at a speed at least twenty times faster than its usual speed. For this purpose the high speed motion must be under the control of one of the numerous forms of seismoscopes, or starters, which set off the high speed motion whenever the intensity of the earthquake motion attains a certain fixt degree. Now the duration of sensible earthquakes is, as a rule, less than one minute. Therefore all reasonable demands will be met if, after the high speed motion has been started, it be stopt after a run of, say, three minutes. That is to say, the drum, having once been set going at the high speed, will automatically resume its slow speed at the expiration of three minutes, or any similar interval that may be judged sufficient. It is a simple matter to meet such a requirement and also to provide that the drum shall automatically assume the high speed and return to the ordinary speed as many times, within reasonable limits, as the circumstances may require.

Summarizing, we find, therefore, that having a perfectly free steady mass we are able to record every species of horizontal vibrations if we provide a set of duplex recorders—one photographic, with high magnification, and the other mechanical, with low magnification, the latter capable of running at a high speed for short runs whenever set off by a mechanical starter of appropriate design.

Additional requirements for satisfactory photographic registration.—The photographic records of earthquakes from ordinary seismographs are all very unsatisfactory. The record may be very fine and sharply inscribed as long as there is no earthquake. The very small earthquake waves are also finely recorded, but just as soon as the waves become large the trace gets fainter and presently vanishes from the record entirely, except at the very extremities of the waves. For a long time the writer regarded this as wholly unavoidable, for

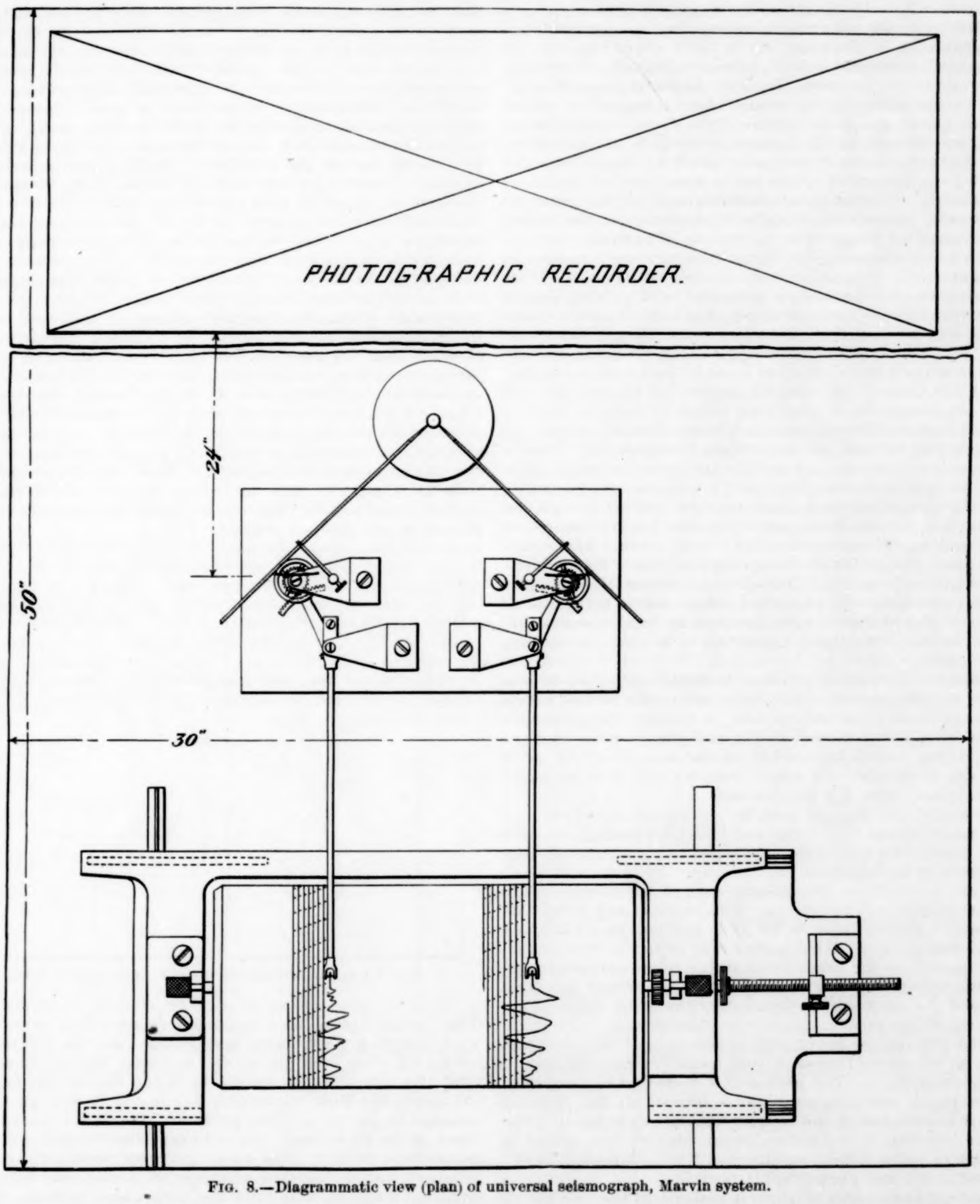

FIG. 8.—Diagrammatic view (plan) of universal seismograph, Marvin system.

some reason imperfectly understood, and he supposed that the photographic film would not take a record of the large wave motion without becoming fogged or blurred when the waves subsided. This idea was at once investigated when he saw the advantages and necessity of using the photographic record in the universal seismograph. The result of the test demonstrated at once that the difficulty lies entirely with the light. The paper will stand many times the range of exposure required. In extreme cases of wave motion the velocity of the spot of light over the paper is something like 300 times as fast as the motion of the paper alone when the spot of light is at rest. Now the photographic record should show any wave

that comes within the limits of the sheet, and this requires a light 300 times stronger than necessary just to make the record in the absence of waves.

The chief reason why existing seismographs fail to get a full photographic record arises from the fact that to get the desired magnification the light and the photographic record sheet are placed at a great distance (10 to 15 *feet* in some cases) from the seismograph. A distance of 20 to 24 *inches* suffices in the design herein described, and something like a forty-fold advantage is gained on this account alone in the question of illumination. A great gain is also realized in the matter of sharpness of image, etc. Finally, it is easy to get the necessary intensity of illumination by the use of suitable combinations for concentrating the light from ordinary sources of illumination.

The results and conclusions presented in this paper are not simply speculations, but are based on actual mechanisms and experiments conducted with the large seismograph illustrated in fig. 4. The steady mass weighs about 1,300 pounds and serves to actuate two mechanical records, each with magnification of 120 times. The vertical support of the steady mass was made exceptionally long (total length 17 feet), in order to test and experiment with certain phases of seismograph construction that we have not as yet fully investigated. Numerous records with pen and ink and the highly magnified smoked-paper records have been secured day by day for some two months past, and our conclusions are thus derived from actual experience. A new instrument with the duplex records is under construction and will embody every feature finally perfected and developed in the foregoing analysis of the problem.

Description of recorder.—It seems unnecessary to enter into details concerning the recorders, since such a multitude of devices of this character are in common use on all classes of instruments that it is largely a question of selecting something to one's taste.

After a considerable experience the writer is inclined to prefer for seismic records that form in which the record sheets are in the shape of an endless belt, or ribbon. Seismographs require large, long, record sheets, and this is easily realized in the ribbon or belt form, while at the same time the clock drum can be of relatively small diameter, and thus be easier to handle and drive at a regular rate.

The use of the endless band for the record sheet requires some simple means of joining and easily separating the ends of the sheet. An admirable scheme for this purpose has been suggested by my assistant, Mr. Maring. Four or more small holes are punched in the opposite ends of the sheet, so as to register exactly, and the ends are then overlapt and a very thin and narrow metal ribbon, *m*, laced in and out thru the holes, as indicated in fig. 9. This is admirably suited to the smoked-paper records, as the small metal ribbon offers only the slightest obstruction to the stylus, and when the record has been inscribed the ends can be detached without the slightest obliteration of the record.

Still a different means of joining the ends of the paper and giving an even smoother seam with some other advantages, is also shown in fig. 9. Two gashes *a b*, *a′ b′* are first cut in one end of the paper, and tongues *t* and *t′* formed on the opposite end are interlocked in the manner shown. It is hardly practicable, however, to separate a soot-coated ribbon united in this fashion without defacing the record, but the method is well adapted to ink and photographic records.

A very great economy of paper is realized by the well-known method of traversing the sheet several times with a slight lateral displacement of each succeeding trace. This, however, introduces mechanical difficulties in the design of the clock and drum in order to secure the lateral shift necessary. To the writer it seems decidedly best to mount the clock and drum on a small carriage which itself shifts endwise, rather than to follow the usual construction. Only in this way is it possible to realize the best results, that is, (1) the whole recorder can be made the most compact possible; (2) the drum and its axis can be made most cheaply and of the simplest construction; (3) the clock can most easily drive such a drum smoothly and regularly; (4) the endwise motion can be more easily effected and a greater amount of motion provided for; (5) two components of motion on large records side by side can be obtained on a single drum, thus securing compactness and avoiding unnecessary expense for separate clocks, drums, etc.

A general design for such a recorder is shown in fig. 10. The clock and drum are mounted in definite and positive working relation to each other on the carriage *A*, which runs on the usual small steel balls, giving the easiest kind of motion. The endwise motion is given by the screw *S*, which is connected with a suitable wheel in the clock train. A point of special merit in this arrangement is the peculiar nut employed. This nut is carried on the bracket *B*. The screw *S* passes loosely thru a hole in the top of *B*. A small worm wheel, *W*, is inserted into a recess milled out in the top of *B* in such a manner as to engage the threads of the screw, and thus serve as a nut. A thumbscrew is now provided by means of which the worm wheel can be clamped in its recess, in which case the carriage and drum are locked and can move endwise only as the clock revolves the screw *S*. When the thumbscrew is loosened a part of a turn, the worm wheel is free to revolve, and the drum and carriage can be shifted endwise at pleasure and set in any position desired.

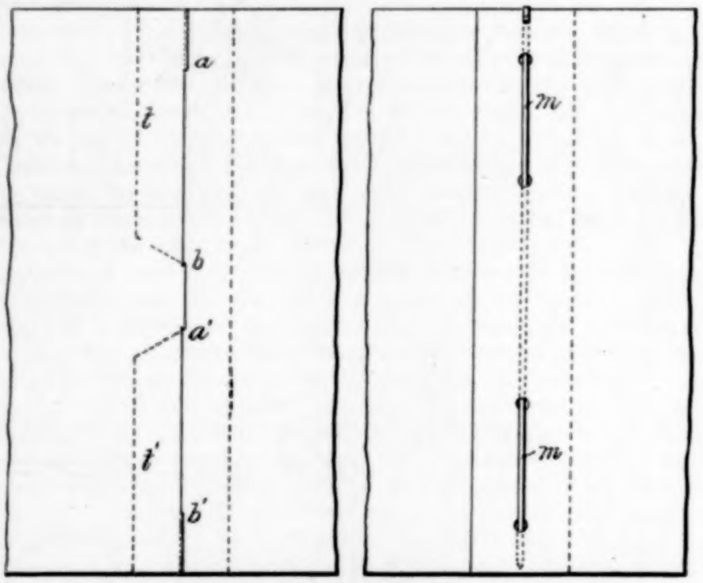

FIG. 9.—Methods of joining the ends of the record sheet.

Two-speed movement of drum.—As already explained, the drum must revolve at a rapid rate (about 0.2 of an inch per *second*) during destructive earthquakes, and at a slow rate (about 0.6 of an inch per *minute*) at other times. To accomplish this alteration of speeds from the slow to the fast and the fast to the slow, we employ a clock with two governors attached to the train. One governor permits the clock to run down at the slow speed; the ordinary balance-wheel and lever escapement, in fact. The other governor ordinarily is held in check, and is released whenever an earthquake occurs of sufficient intensity to require the high-speed motion. When this train has run at the high speed for three minutes of time, it automatically stops. The slow speed governor, which has been running all the time, thereupon resumes control of the rate of motion.

The exact form of clock with duplex governor now being constructed will be described at some subsequent time, also

the very simple devices employed to start and stop the high speed and mark the time on the record sheets.

IV. DAMPING.

General requirements.—If we fix our attention again on the second type of steady mass previously described, that is, the simple inverted pendulum, we may regard twenty to thirty seconds as a good working period that may be realized. As we have already indicated, such a steady mass will not, ordinarily, remain at rest satisfactorily when subjected to long-period ground motions, and some expedient must be resorted to in order to overcome this difficulty, if possible. With this object in view, the German seismologists, especially, have introduced various methods of damping the motions of the steady mass. We must not regard damping as broadly beneficial; it is more in the nature of a necessary evil. It does not help the steady mass to remain at rest; indeed damping tends to set the steady mass in motion. Nevertheless, the motion thus set up is controlled in such a fashion that under certain assumptions we can compute from the record with more or less exactness the actual motions of the steady mass, or rather the true motions of the ground. The assumptions we are obliged to make do not always fit the facts satisfactorily, and the results are accordingly inexact. Damping, therefore, is to be shunned, rather than otherwise, and used just as sparingly as possible. The only way this can be accomplished is to use a form of steady mass whose period is the longest practicable, consistent with other desirable results.

It is important that a clear idea be formed of the nature of damping in its most desirable form. Damping in any form is some sort of resistance that opposes, but at the same time permits, relative motion between the steady mass and its immediate environment. The resistance may be offered by the motion of blades or paddles submerged in a liquid, for example, or by vanes of appropriate arrangement that fan the air in a certain sense. The resistance may even be derived from electro-magnetic reactions. Instruments in which no particular devices for damping are employed are, nevertheless, often very strongly damped by friction, especially in the levers and linkages and at the point of the stylus employed in magnifying and inscribing the record. This frictional damping is perhaps the most objectionable of all, because it does not conform to any available mathematical law for the computation of the desired results.

Damping to be beneficial must strongly oppose large and rapid motion of the steady mass, but at the same time it must not offer the slightest resistance to the steady mass slowly assuming perfectly its position of equilibrium. This is realized in the resistance of vanes moving either in some liquid, or better in confined air spaces. The appropriate mathematical expression of course affords the most complete and elegant definition of the nature and effect of damping. In the absence of earthquake motion the record traced by a seismograph under some kind of fluid or electro-magnetic damping, when the steady mass has been displaced, is represented by an equation of this form:

$$x = Ae^{-\epsilon t} \sin\left(\frac{2\pi}{T} + a\right)$$

x is the ordinate of the curve at any time t, ϵ is the measure of the damping; A and a are constants, T is the period of the damped oscillations.

Broadly speaking, strong damping has the effect on a seismograph of making the magnifying scale of the record depend on the *period* of motion registered, so that only short-period waves, which as a rule are met with only in damaging or felt earthquakes, are registered approximately fully magnified, whereas the slow waves, which are of frequent occurrence in all long-distance earthquakes, are magnified only very slightly, and as a consequence the *small* slow waves may be lost altogether. In some cases the damping may also be a function of the *amplitude* as well as the *period* of the waves, and the mathematics of the problem becomes very complex. These are some of the reasons which make damping objectionable.

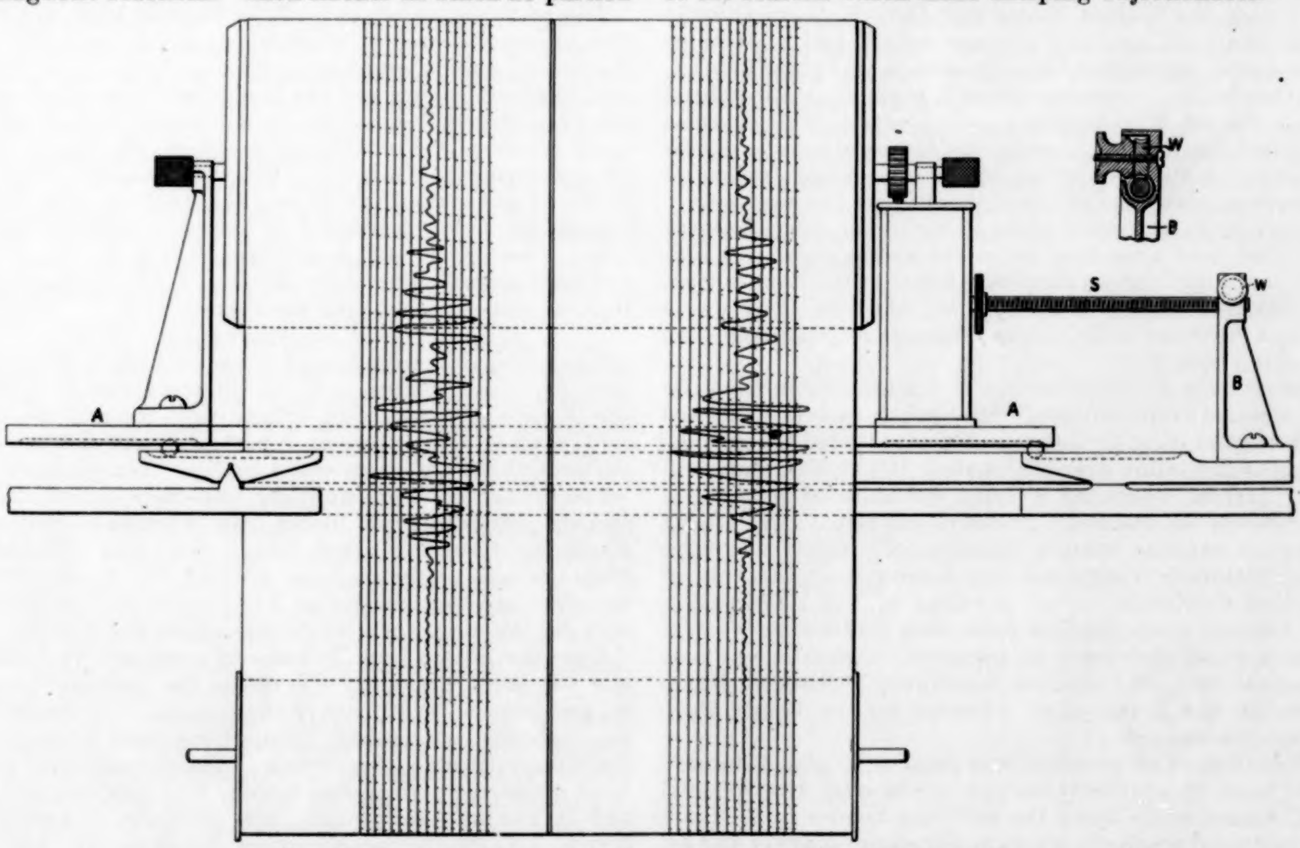

FIG. 10.—Front elevation of recording drum and carriage, Marvin system.

It should be clearly understood that strong damping by *friction* is fundamentally undesirable, since *all* small waves are lost altogether, and large motions are only slightly controlled by the friction. Strong damping, even if of a nature that satisfies the equation given above, is still undesirable, because small *slow* waves are likely to be lost altogether, and larger slow ones are not sufficiently magnified. Nevertheless, when the damping is of this sort, and its magnitude ε in the equation is known, we can compute under certain favorable conditions the actual magnitude of the ground movements. Finally, when friction and damping are both quite small, the instrument is highly sensitive to all minute disturbances, especially motions of nearly its own period. Such motions, however, are likely to be recorded on a greatly exaggerated scale. In general, the deductions and conclusions from a record made on a frictionless instrument of moderate period only slightly damped must be very carefully drawn. The steady mass in these cases acquires certain of the properties of "sensitive masses" previously mentioned.

Galitzin has greatly developed and employed electro-magnetic devices for damping, and for this purpose attaches to the steady mass one or more heavy copper plates, which are free to move between the poles of an electro-magnet. When the magnet is energized, movements of the steady mass are more or less strongly damped by the generation of electric currents in the copper plates. By a suitable disposition of this apparatus the same investigator causes the electric currents thus generated to record photographically the character of the motion. As the *velocity* of the relative motion of the ground and the steady mass, not the *displacement*, is shown by the electric recorder, it seems the data furnished by such records are not in the most convenient form.

The work of the present writer has thus far been directed very largely to the best methods of constructing the seismograph so as to secure what he has called earthquake-proof construction, universality, the longest practicable periods, etc., thereby reducing the necessity for damping to a minimum. It is intended, however, later on to investigate fully the effect of different forms and degrees of damping on actual instruments of the new design.

From a superficial examination of various actual records and effects from ordinary instruments, I find the damping often differs very widely in character from that represented by the logarithmic equation given above, and can not be represented by a simple exponent ε, such as is often employed in the reduction of observations. The subject is one requiring very careful attention.

PUBLICATION OF CLIMATOLOGICAL DATA FROM COOPERATIVE OBSERVERS.

It is anticipated that beginning with the issue of January, 1908, Table II and Table III will be omitted from the MONTHLY WEATHER REVIEW.

Those desiring the data hitherto published in Table II for any State or Territory, or group of States, or for the whole country, may obtain them in the monthly reports of the appropriate section or sections of the Climatological Service of the Weather Bureau. Application for such reports may be addrest to "Chief U. S. Weather Bureau, Washington, D. C., for the Climatological Division", or to the officials in charge at the proper section centers.

THE WEATHER OF THE MONTH.

By Mr. P. C. DAY, Assistant Chief, Division of Meteorological Records.

PRESSURE.

The distribution of mean atmospheric pressure for November, 1907, over the United States and Canada, is graphically shown on Chart VI, and the average values and departures from the normal are shown for each station in Tables I and V.

From October to November there is normally a substantial increase in the sea-level pressure over practically all portions of the United States and Canada, the increase being greatest over the interior districts, owing to the more rapid cooling of the continental area than of the districts near the seacoasts.

The increase in pressure during November over that for October, 1907, was more than twice the average over the central portions of the Plateau district, while over the Lake region, Ohio Valley, and middle Atlantic coast districts there was a pronounced decrease in the mean pressure as compared with the preceding month.

Over practically all districts in the United States from the Lake region and Ohio and lower Mississippi valleys westward to the Pacific the monthly mean pressure exceeded the normal, attaining the maximum over the central Rocky Mountain and Plateau districts, where an average pressure of more than 30.20 inches was maintained. Pressure was also comparatively high over the extreme eastern Canadian Provinces and over the lower Colorado Valley and the surrounding districts of Arizona and California. Over portions of the Lake region and the Atlantic coast districts from New England to Florida there was a small deficiency in pressure. Pressure was also below normal over the Canadian Northwest Territories, where at Edmonton the lowest mean pressure for the month, 29.90 inches, was maintained.

The distribution of pressure was such as to give a decided preponderance of northerly surface winds over the Atlantic and Gulf States, while along the northern border from North Dakota westward southerly winds modified the weather and extended their influence far to the northward over the Canadian Northwest Provinces.

The eastward movements of the areas of high and low pressure across the country were along paths generally south of the normal course, and large portions of the upper Mississippi and Missouri valleys and the slope region were not under the influence of any decided storm movement during the month. As a result of the southward trend of the storm tracks, the wind movement along the Gulf and Atlantic coasts was in excess of the normal, while over the districts from the middle Mississippi Valley westward there was a general diminution of wind movement, which was especially pronounced over the southern slope, where the velocities of the wind ranged from 10 to 40 per cent less than the average.

TEMPERATURE.

The unusual congestion of areas of high and low pressure over the Gulf States and the preponderance of northerly winds, with an excess of cloud and rain, brought unseasonably cold weather over the greater part of Texas and the southern portions of the cotton-growing States. Temperature was also below the normal over the lower Lake region, the Ohio Valley, and the Atlantic coast States from Florida to southern New England. Over the upper Lakes, the upper Mississippi and Missouri valleys, the districts west of the Rocky Mountains, and the Canadian Northwest Territories the average temperature for the month was uniformly above the normal.

Over the States from Minnesota westward to Idaho and in the adjoining Canadian Provinces the average temperature ranged from 6° to 10° above the normal. No severe cold was experienced and outdoor occupations were pursued thruout the month without interruption. Temperature was also somewhat above the normal over central New England and Florida, and it was unusually warm over portions of southern California. Maximum temperatures between 80° and 90° oc-

curred over Florida, the immediate Gulf coast, and the southern portions of Arizona and California, while over the Lake region and New England they ranged from 50° to 60°, and at a few points were slightly less than 50°. Temperatures below zero were confined to the portion of North Dakota east of the Missouri River and the adjoining portions of Minnesota and to points in the higher levels of the mountain regions of Wyoming and Colorado.

While no severe cold waves overspread the northern districts, unusually cold weather penetrated the Gulf States about the middle of the month, and temperatures of 32° or lower were recorded to the coast line and into northern Florida. No frosts occurred over the southern portion of Arizona, the lower levels of California, or along the coasts of Oregon and Washington.

PRECIPITATION.

Heavy rainfall, from 6 to 10 inches, occurred over eastern and central Texas, central and southern Arkansas and western Louisiana, also over a narrow area from southern Mississippi thru central Alabama to northwestern Georgia.

Amounts slightly above 6 inches were general along the Atlantic coast from Chesapeake Bay to southern New England, and from 6 to 10 inches along the coast districts of Oregon and Washington. Over the western slopes of the Coast and Cascade ranges in those States the fall was heavy, ranging from 10 to 25 inches at exposed points.

Precipitation was from 4 to 6 inches above the normal over the central parts of Texas, Arkansas, and Alabama, and generally more than 2 inches above over all districts from Texas northeastward over the cotton region States, Tennessee, the Middle Atlantic States, and New England. Along the immediate Atlantic coast from Virginia southward, including the Florida Peninsula, precipitation was below the normal, and a general deficiency prevailed over the Lake region, the Ohio Valley, and all districts west of the Mississippi Valley, except over the greater part of Texas and at points on the western slopes of the Coast and Cascade ranges of Washington and Oregon. Over a large portion of California and western Washington the deficiency amounted to from 2 to 3 inches.

Thruout the entire mountain and Plateau districts, the Great Plains from the Texas panhandle northward to Canada, and the upper Mississippi Valley, the amounts of precipitation for the month were generally less than one inch and occurred mostly in the form of light showers.

In California the progress of the rainy season, the opening of which occurred unusually early in October, was temporarily suspended during November, and in portions of the State it was the driest month of its name in many years.

The lack of moisture over the Florida Peninsula noted in the previous month continued till near the end of November, when general rains relieved the droughty conditions.

Generous and well-distributed amounts of precipitation occurred over the Gulf States, Appalachian Mountain districts, and New England, and rain was almost continuous during the latter half of the month over the western portions of Oregon and Washington.

SNOWFALL.

Snow, in small amounts generally, occurred over nearly all portions of the United States, the exceptions being the Atlantic coast districts south of Virginia, the greater part of the Gulf States, the lower elevations of New Mexico, Arizona, and California, and the western portions of Oregon and Washington. Depths of 12 inches or more occurred in the White and Adirondack and in the higher elevations of the Appalachian mountains, over upper Michigan and along the western slopes of the Main Divide from Idaho to New Mexico. There was also considerable snow in the mountains of Oregon, but over the greater part of the Mountain and Plateau districts, the Great Plains, central valleys, and Lake region, the total fall for the month was generally less than 1 inch.

At the end of the month the high western slopes of the mountains of northern Idaho were covered to depths of several feet, and there was considerable snow in the interior of New England, in the mountainous portions of northern New York, and over the upper Lake region; elsewhere but little snow remained on the ground.

HUMIDITY AND SUNSHINE.

The relative amount of moisture in the atmosphere was decidedly less than the average over the entire Mississippi and Missouri valleys, the north Pacific coast, and at points on the Atlantic coast.

Over the central and southern Plateau and Rocky Mountain districts and in western Texas the relative humidity, as in October and the preceding months of the year, was far above the average. Over western Texas, New Mexico, Arizona, Nevada, and portions of California, Colorado, and Utah, it ranged from 10 to 25 per cent above the normal.

Cloudy weather was general from the Lake region and Ohio Valley eastward over the Middle Atlantic and New England States, over the greater part of Texas and the western portions of Oregon and Washington, where the amount of clouds ranged from 70 to 80 per cent of the possible.

Over the middle Mississippi and Missouri valleys, the slope, mountain, and Plateau districts, there was a uniform absence of clouds and the amount of sunshine ranged from 60 to 80 per cent of the possible.

As a whole, November, 1907, was a cold, disagreeable month over the Gulf and portions of the Atlantic coast districts; but over the States of the corn belt and nearly all portions of the mountain, Plateau, and central and southern Pacific coast districts the weather was uniformly warm and dry, with an abundance of sunshine.

WEATHER IN ALASKA.

A severe cold wave for the season overspread the upper Yukon and the Copper River plateau during the first week of the month, with minimum temperatures from 30° to 40° below zero.

During the period from the 10th to the 20th mild and generally fair weather prevailed, but from the latter date to the end of the month cold weather again prevailed, the minimum temperatures ranging from 15° to 35° below zero and the maximum from zero to 15° below.

Over the southeastern and southern districts the weather continued mild, with about the normal amount of precipitation and the usual number of cloudy days. But little snow appears to have fallen in the interior districts, and the depth on ground had probably increased but little over that at the end of the preceding month.

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	12	40.2	+ 0.6	−23.0	− 2.1
Middle Atlantic	16	44.2	− 0.2	−15.8	− 1.4
South Atlantic	10	53.5	− 0.6	+ 4.8	+ 0.4
Florida Peninsula*	8	67.5	+ 1.1	+12.6	+ 1.1
East Gulf	11	54.2	− 1.5	+14.6	+ 1.3
West Gulf	10	53.8	− 2.1	+18.3	+ 1.7
Ohio Valley and Tennessee	13	44.0	− 1.2	− 6.5	− 0.6
Lower Lake	10	38.5	− 0.4	−22.5	− 2.0
Upper Lake	12	35.1	+ 1.0	−14.6	− 1.3
North Dakota*	9	30.0	+ 6.1	−19.7	− 1.8
Upper Mississippi Valley	15	39.0	+ 1.2	− 9.0	− 0.8
Missouri Valley	12	40.0	+ 2.6	+ 0.2	0.0
Northern Slope	9	35.1	+ 3.4	− 4.1	− 0.4
Middle Slope	6	42.4	+ 0.6	+12.1	+ 1.1
Southern Slope*	7	48.0	− 2.0	+17.2	+ 1.6
Southern Plateau*	12	47.4	− 0.2	+ 0.7	+ 0.1
Middle Plateau*	10	37.4	+ 0.1	+10.2	+ 0.9
Northern Plateau*	12	39.9	+ 3.2	+ 0.2	0.0
North Pacific	7	47.7	+ 2.6	+ 0.9	+ 0.1
Middle Pacific	8	54.6	+ 1.0	− 1.0	− 0.1
South Pacific	4	59.6	+ 2.6	+ 7.2	+ 0.7

* Regular Weather Bureau and selected cooperative stations.

In Canada.—Director R. F. Stupart says:

The mean temperature of November was higher than the average thruout the Western Provinces and in British Columbia, the widest departure, about 10°, occurring in Alberta and Saskatchewan. In Ontario the departure was very generally negative by 1° or 2°, while in Quebec and the Maritime Provinces the mean of the month ranged from just average to 2° above. From Ontario to the Maritime Provinces there were but two fairly pronounced cool periods, namely, from the 12th to the 16th, and again during the last few days of the month.

Average precipitation and departures from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		*Inches.*	*Inches.*
New England	12	4.79	133	+1.2	− 1.9
Middle Atlantic	16	4.31	153	+1.5	− 1.8
South Atlantic	10	3.23	114	+0.4	−11.0
Florida Peninsula *	8	1.51	68	−0.7	− 9.5
East Gulf	11	5.76	162	+2.2	− 1.5
West Gulf	10	6.24	181	+2.8	− 5.2
Ohio Valley and Tennessee	13	3.26	94	−0.2	− 2.2
Lower Lake	10	2.12	70	−0.9	− 1.7
Upper Lake	12	1.74	71	−0.7	− 2.6
North Dakota *	9	0.11	14	−0.7	− 1.9
Upper Mississippi Valley	15	1.52	72	−0.6	+ 1.4
Missouri Valley	12	0.70	58	−0.5	− 2.9
Northern Slope	9	0.36	42	−0.5	+ 0.4
Middle Slope	6	0.42	46	−0.5	− 1.7
Southern Slope *	7	1.45	94	−0.1	− 0.5
Southern Plateau *	12	0.32	44	−0.4	+ 3.4
Middle Plateau *	10	0.29	33	−0.6	+ 1.6
Northern Plateau *	12	1.01	63	−0.6	+ 1.0
North Pacific	7	6.07	85	−1.2	−11.1
Middle Pacific	8	0.46	16	−2.5	+ 0.3
South Pacific	4	0.02	2	−1.2	+ 1.3

* Regular Weather Bureau and selected cooperative stations.

In Canada.—Director Stupart says:

The precipitation was heavy over the lower mainland of British Columbia and comparatively light on the upper mainland; 13.4 inches were recorded at Vancouver, 8.4 inches at Agassiz, and but 0.6 inch at Kamloops. In the Western Provinces it was almost nil, ranging from just a few snow flurries in Alberta to an aggregate of 0.15 inch of rain and about 4 inches of snow in Manitoba. Over the greater portion of Ontario the precipitation was part rain and part snow, but chiefly the former. It was generally in excess of the average, except near the shore lines of the lakes, where there was a small deficiency. In Quebec and the Maritime Provinces departures from the average amount were not pronounced, except in Prince Edward Island, where the quantity recorded was much below the average and decidedly less than in New Brunswick and Nova Scotia.

At the close of the month there was a light covering of snow over the whole of Quebec and over the larger portion of Ontario, while in parts of this latter province east and north of the Georgian Bay as much as 12 inches was reported. In northern New Brunswick there was also a light covering, but farther south and including Prince Edward Island and Nova Scotia there was but a trace here and there. In Manitoba there was from half an inch to 2 inches, but farther west all the prairie lands were quite bare, as were also the lower levels in British Columbia.

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	77	− 1	Missouri Valley	63	− 8
Middle Atlantic	77	+ 2	Northern Slope	68	+ 1
South Atlantic	78	0	Middle Slope	65	+ 3
Florida Peninsula	80	0	Southern Slope	78	+14
East Gulf	73	− 3	Southern Plateau	61	+16
West Gulf	73	− 1	Middle Plateau	62	+ 8
Ohio Valley and Tennessee	72	− 1	Northern Plateau	69	− 3
Lower Lake	78	+ 1	North Pacific	87	+ 3
Upper Lake	77	− 3	Middle Pacific	70	− 2
North Dakota	76	− 3	South Pacific	66	− 1
Upper Mississippi Valley	72	− 2			

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	6.6	+ 1.0	Missouri Valley	4.0	− 0.9
Middle Atlantic	6.3	+ 1.1	Northern Slope	4.2	− 0.4
South Atlantic	5.4	+ 0.9	Middle Slope	3.4	− 0.2
Florida Peninsula	4.4	− 0.2	Southern Slope	5.8	+ 2.1
East Gulf	5.4	+ 0.9	Southern Plateau	2.9	+ 0.7
West Gulf	5.1	+ 0.5	Middle Plateau	3.2	− 0.2
Ohio Valley and Tennessee	5.7	0.0	Northern Plateau	5.3	− 0.5
Lower Lake	7.3	+ 0.1	North Pacific	7.1	− 0.6
Upper Lake	6.7	− 0.3	Middle Pacific	4.1	+ 0.1
North Dakota	4.9	− 0.4	South Pacific	2.4	− 0.8
Upper Mississippi Valley	4.3	− 1.0			

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Atlanta, Ga.	6	50	nw.	Nantucket, Mass.	6	68	e.
Block Island, R. I.	6	64	ne.	Do	7	50	sw.
Do	7	51	w.	Do	24	56	ne.
Do	24	70	ne.	Do	25	55	ne.
Do	25	64	ne.	New York, N. Y.	14	52	nw.
Buffalo, N. Y.	13	60	sw.	North Head, Wash.	1	60	se.
Do	21	51	s.	Do	18	60	se.
Do	28	50	w.	Do	19	68	se.
Chicago, Ill.	20	52	sw.	Do	20	60	s.
Cleveland, Ohio	6	52	nw.	Do	21	52	s.
Concord, N. H.	6	50	ne.	Do	23	64	s.
Detroit, Mich.	21	50	sw.	Do	25	74	s.
Eastport, Me.	3	50	s.	Do	28	62	se.
Do	6	58	e.	Point Reyes Light, Cal.	13	64	nw.
Do	7	60	e.	Do	16	70	nw.
Do	25	54	e.	Do	17	69	nw.
Erie, Pa.	20	55	se.	Do	19	50	nw.
Hatteras, N. C.	6	58	w.	Seattle, Wash.	23	51	s.
Do	7	50	nw.	Southeast Farallon, Cal.	17	55	nw.
Mount Tamalpais, Cal.	13	52	nw.	Tatoosh Island, Wash.	1	60	s.
Do	17	51	n.	Do	2	56	sw.
Do	18	53	n.	Do	3	60	s.
Do	19	58	nw.	Do	4	60	s.
Do	20	52	nw.	Do	8	54	e.
Do	25	50	nw.	Do	9	54	e.
Mount Weather, Va.	3	52	nw.	Do	18	60	s.
Do	6	57	w.	Do	21	60	s.
Do	7	64	w.	Do	23	53	sw.
Do	26	58	nw.	Do	25	72	s.
Do	27	56	nw.	Do	28	64	s.
				Toledo, Ohio	21	53	s.

CLIMATOLOGICAL SUMMARY.

By Mr. JAMES BERRY, Chief of the Climatological Division.

TEMPERATURE AND PRECIPITATION BY SECTIONS, NOVEMBER, 1907.

In the following table are given, for the various sections of the Climatological Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Section.	Temperature—in degrees Fahrenheit.								Precipitation—in inches and hundredths.					
	Section average.	Departure from the normal.	Monthly extremes.						Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
Alabama	51.4	− 2.1	Goodwater Wetumpka	82 82	9 9	Valley Head	16	15, 16	6.15	+ 3.17	Mobile	9.90	Flomaton	2.50
Arizona	53.1	− 0.8	Parker	92	4	Chiarsons Mill	9	24	0.93	− 0.14	Huachuca Reservoir	4.78	5 stations	0.00
Arkansas	49.0	− 1.6	Benton	84	5	Pond	10	13	5.71	+ 2.08	Benton	9.32	Pond	1.97
California	53.7	+ 1.0	3 stations	92	2, 5	Tamarack	4	18	0.28	− 2.50	Monumental	8.77	Many stations	0.00
Colorado	33.3	− 1.1	Holly	79	6	Wagonwheel Gap	−14	21	0.34	− 0.17	Rocky Ford	2.00	Alamoso	0.00
Florida	64.7	− 0.8	Orange City	92	22	Molino	26	14	2.54	+ 0.38	Wausau	18.63	Orlando	0.29
Georgia	52.9	− 1.5	Quitman	90	22	Greenbush	21	15	5.16	+ 2.54	Clayton	8.77	St. Marys	1.07
Hawaii	71.2†		Kihei, Maui	89	1, 4	Humuula, Hawaii	36	26	5.90‡	......	Honomanu Val. Maui	25.04	2 stations	0.00
Idaho	36.9	+ 1.1	Emmett Hotspring	67 67	1 1	Roosevelt	− 3	26	1.25	− 0.86	Wallace	5.37	Driggs	0.05
Illinois	40.1	− 0.5	Mount Vernon	73	5	Dixon	4	16	2.31	− 0.37	Cobden	5.17	La Harpe	0.90
Indiana	39.7	− 1.7	Rome	75	8	Northfield	11	16	2.79	− 0.80	Mount Vernon	4.83	Lafayette	1.32
Iowa	36.7	+ 1.3	Baxter	68	6	Elma	− 4	14	1.03	− 0.29	Logan	2.27	Sioux City	0.05
Kansas	42.6	+ 0.1	Anthony Liberal	82 82	8 6	Norton	− 4	12	0.82	− 0.17	Oswego	2.23	3 stations	T.
Kentucky	44.2	− 2.3	3 stations	75	5, 8, 9	Farmers	15	30	3.49	− 0.26	Blandville	5.47	Frankfort	1.21
Louisiana	55.6	− 3.3	Schriever	91	8	Minden Plain Dealing	17 17	13, 14 13	5.84	+ 2.15	Logansport	10.32	Robeline	3.25
Maryland and Delaware	43.1	− 0.4	College Park, Md. Millsboro, Del.	70 70	2 9	Deer Park, Md.	10	30	5.33	+ 2.45	Coleman, Md.	8.45	Delaware City, Del.	3.30
Michigan	35.2	− 0.5	Coldwater	65	1	Humboldt	− 3	16	2.15	− 0.36	South Haven	5.84	Plymouth	0.35
Minnesota	31.7	+ 2.8	New Ulm St. Charles	62 62	17 4	Blackduck Hallock	− 8 − 8	30 29	0.59	− 0.44	Caledonia	1.40	2 stations	T.
Mississippi	51.9	− 2.8	Aberdeen	85	5	Fayette	16	14	5.56	+ 2.33	Waynesboro	9.40	Clarksdale	3.13
Missouri	43.8	− 0.1	Eldorado Springs	88	7	Houston	5	13	2.52	+ 0.24	Caruthersville	6.03	Sublett	0.55
Montana	35.8	+ 4.8	Billings	72	6	Busby Jordan	− 7 − 7	11 11	0.43	− 0.80	Snowshoe	9.03	3 stations	0.00
Nebraska	37.0	+ 0.4	Callaway Oakland	77 77	6 1	Scottsbluff	−11	12	0.29	− 0.35	Syracuse	2.12	8 stations	0.00
Nevada	40.2	+ 0.9	Las Vegas Logan	78 78	1 1	McAfees Ranch (Dyer)	− 1	29	0.21	− 0.55	Austin Fenelon	1.00 1.00	9 stations	0.00
New England*	38.0	0.0	Millinocket, Me.	69	3	Van Buren, Me.	0	20	5.06	+ 0.95	Kingston, R. I.	8.03	Houlton, Me	2.10
New Jersey	43.5	0.0	Browns Mills	68	5, 9	Layton	13	15	5.65	+ 2.34	Egg Harbor City	6.95	Hightstown	4.19
New Mexico	40.5	− 1.9	4 stations	80	4 dates	Luna	− 9	19	0.82	0.00	Cloudcroft	4.00	San Marcial	T.
New York	36.8	− 0.4	Cutchogue	68	3	Faust	2	30	3.63	+ 0.71	Ticonderoga	7.95	Chazy	1.08
North Carolina	48.2	− 1.4	Clinton Southern Pines	80 80	22 8	Banners Elk	15	30	4.78	+ 1.95	Horse Cove	9.22	Clinton	1.58
North Dakota	30.2	+ 6.0	Pratt	85	7	Pratt	−15	14	0.09	− 0.60	Edmore	0.60	2 stations	0.00
Ohio	39.1	− 1.9	Ironton	71	8	Bladensburg	11	15	1.93	− 1.05	Jacksonburg	3.58	Oberlin	0.72
Oklahoma	47.7	− 1.8	Chattanooga	86	5	Kenton	6	12	1.59	− 0.51	Idabel	5.22	Harrington	0.17
Oregon	44.3	+ 1.7	Bay City	81	9	Silver Lake Wamic	11 11	20 18	4.91	− 1.02	Glenora	25.45	Huntington	0.01
Pennsylvania	39.8	− 0.7	Derry Station	70	21	Pocono Lake	4	30	3.60	+ 0.57	Coatesville	7.52	Erie	1.05
Porto Rico	76.4	......	Central Aguirre	98	13	Aibonito	46	29	5.46	......	Sabana Grande	20.04	Guayama	0.56
South Carolina	52.2	− 1.9	Anderson	87	5	Dillon Saluda	24 24	14 15	4.13	+ 1.32	Greenwood	8.25	Charleston	1.22
South Dakota	34.9	+ 3.5	Philip	79	6	Montrose	− 4	12	0.05	− 0.55	Vermilion	0.25	2 stations	0.00
Tennessee	46.5	− 1.6	Ashwood	79	8	Rugby	12	14	4.82	+ 0.91	Loudon	6.55	Elizabethton	3.15
Texas	53.3	− 3.3	Falfurrias	90	9	Plemons	7	12	5.40	+ 3.60	Crockett	13.60	Channing	0.29
Utah	37.4	− 0.6	Richfield Springdale	79 79	11 9	Loa	− 8	18	0.34	− 0.64	Sunnyside	0.80	St. George	0.00
Virginia	44.7	− 1.5	Norfolk	76	9	Burkes Garden	13	17	4.84	+ 2.33	Big Stone Gap	8.35	Marion	2.94
Washington	43.7	+ 2.7	Ephrata	78	2	Northport	10	27	4.61	− 0.69	Clearwater	26.22	Sunnyside	0.19
West Virginia	41.8	− 1.6	Doane Logan	74 74	8 8	4 stations	13	3 dates	3.40	+ 0.13	Leonard	7.05	Spencer	1.41
Wisconsin	33.8	+ 1.0	Beloit	60	27	Prentice	0	14	1.20	− 0.42	Sturgeon Bay	2.26	Crandon	0.20
Wyoming	32.3	+ 0.7	Pine Bluff	79	5	Fort Laramie	−14	12	0.37	− 0.27	Snake River, Y. N. P.	1.41	Lusk	0.00

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut. † 51 stations, with an average elevation of 701 feet. ‡ 144 stations.

DESCRIPTION OF TABLES AND CHARTS.

By Mr. P. C. DAY, Assistant Chief, Division of Meteorological Records.

For description of tables and charts see page 30 of REVIEW for January, 1907.

TABLE I.—*Climatological data for U. S. Weather Bureau stations, November, 1907.*

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.									Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.				Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Direction.	Date.					
New England.							40.2	+ 0.6										77	4.79	+ 1.2										6.6	
Eastport	76	69	85	29.94	30.03	+ .02	38.1	+ 1.3	57	3	43	18	30	33	17	35	32	78	2.85	- 1.2	9	8,854	w.	60	e.	7	2	7	21	8.3	0.3
Portland, Me.	103	81	117	29.92	30.04	.00	38.0	+ 0.4	57	3	44	21	30	32	20	34	30	75	4.40	+ 0.6	10	6,611	w.	48	ne.	6	12	7	11	5.3	2.4
Concord	288	70	79	29.72	30.04	- .02	36.6	- 0.2	57	3	44	15	30	29	31	....	....	....	4.07	+ 0.7	10	3,701	nw.	50	ne.	6	15	4	11	4.8	1.7
Burlington	404	12	47	29.58	30.04	- .01	35.0	- 1.7	58	3	41	13	30	29	27	....	....	....	2.67	+ 0.1	12	8,372	s.	44	s.	21	1	7	22	8.2	12.4
Northfield	876	16	70	29.07	30.04	- .01	32.8	+ 0.8	58	3	41	4	30	24	35	30	27	85	3.32	+ 0.7	13	5,469	s.	46	se.	3	3	4	23	8.0	8.9
Boston	125	115	188	29.90	30.04	- .01	43.2	+ 2.0	61	3	49	25	30	37	21	39	34	73	6.02	+ 1.9	10	7,669	w.	48	ne.	6	5	11	14	6.4	
Nantucket	12	14	90	30.01	30.02	- .03	44.8	- 0.4	61	9	50	31	15	40	17	42	38	80	6.69	+ 3.4	15	12,429	w.	68	e.	6	8	8	14	6.7	T
Block Island	26	11	46	30.00	30.03	- .03	45.0	- 0.3	59	3	49	31	13	41	18	42	37	76	6.35	+ 2.5	14	13,590	nw.	70	ne.	24	5	11	14	6.5	
Narragansett	....	9	....	....	....	....	41.6	- 0.7	59	9	50	17	15	33	32	....	....	....	6.38	....	13	....	w.	....	....	...	14	6	10	....	0.7
Providence	160	57	67	29.87	30.05	- .02	42.4	+ 2.0	61	3	50	25	30	35	26	38	33	74	4.60	+ 0.5	11	5,345	w.	30	se.	3	9	11	10	5.6	T.
Hartford	159	122	132	29.87	30.05	- .03	41.8	+ 2.3	61	2	49	24	30	35	27	37	33	76	4.74	+ 0.9	12	5,039	nw.	35	s.	2	2	12	16	7.0	0.2
New Haven	106	116	155	29.92	30.04	- .03	43.4	+ 2.1	60	3	50	25	15	36	28	39	34	74	6.97	+ 3.4	11	7,114	n.	41	ne.	24	8	10	12	6.0	T.
Mid. Atlantic States.							44.2	- 0.2										77	4.31	+ 1.5										6.3	
Albany	97	102	115	29.94	30.05	- .03	39.0	+ 0.6	61	2	46	25	15	32	28	36	32	80	4.15	+ 1.4	10	5,097	s.	36	se.	2	4	11	15	7.1	6.5
Binghamton	871	78	90	29.10	30.05	- .04	37.4	- 0.2	57	2	44	18	15	30	27	....	....	....	3.09	+ 0.8	12	4,447	w.	27	s.	21	2	6	22	8.3	11.2
New York	314	108	350	29.70	30.04	- .05	45.2	+ 1.2	60	2	50	33	30	40	17	41	37	74	5.05	+ 1.6	11	8,699	w.	52	nw.	14	8	9	13	6.2	T.
Harrisburg	374	94	104	29.68	30.09	- .02	42.4	+ 0.7	60	10	48	26	15	37	24	38	33	75	2.63	+ 0.3	10	5,489	w.	35	nw.	7	9	11	10	5.7	0.8
Philadelphia	117	116	184	29.94	30.07	- .03	46.4	+ 1.5	60	2	52	31	15	40	19	42	38	77	5.85	+ 2.8	11	7,286	nw.	40	n.	24	7	7	16	6.3	0.7
Scranton	805	111	119	29.17	30.05	- .04	39.7	+ 0.6	60	2	46	21	15	33	25	36	32	76	3.05	+ 0.8	9	5,112	sw.	35	s.	2	5	8	17	7.1	10.1
Atlantic City	52	37	48	30.01	30.07	- .03	45.7	+ 0.2	58	3	51	32	17	40	19	42	37	75	5.67	+ 2.4	14	6,395	n.	40	ne.	24	10	5	15	6.2	T.
Cape May	17	48	52	30.07	30.09	- .01	46.4	- 1.0	60	10	51	32	30	41	16	43	....	....	5.85	+ 2.6	16	7,221	n.	36	n.	24	7	11	12	5.9	0.5
Baltimore	123	69	117	29.93	30.07	- .04	45.4	- 0.4	63	10	52	29	15	39	22	41	37	77	5.02	+ 2.1	12	5,307	n.	35	w.	7	8	6	16	6.4	T.
Washington	112	59	76	29.96	30.08	- .04	44.5	- 0.5	65	10	52	24	15	37	29	39	34	75	4.16	+ 1.4	11	5,273	nw.	33	w.	7	9	8	13	6.2	T.
Cape Henry	18	11	58	30.05	30.08	- .02	50.6	- 1.5	72	9	56	34	14	45	23	....	....	....	3.34	+ 0.6	12	11,816	ne.	46	nw.	24	10	6	14	6.0	
Lynchburg	681	83	88	29.35	30.11	- .02	45.2	- 0.9	68	5	54	24	15	37	35	40	36	78	4.47	+ 1.7	10	2,636	ne.	24	nw.	26	8	7	15	6.3	T.
Mount Weather	1,725	10	57	28.19	30.07	- .05	39.6	- 0.8	58	5	45	26	13	34	18	36	31	76	4.21	+ 1.4	10	....	nw.	64	w.	7	10	5	15	6.1	5.6
Norfolk	91	102	111	29.99	30.09	- .02	50.6	- 0.6	76	9	58	31	14	44	27	45	41	76	4.32	+ 1.8	12	7,475	ne.	32	nw.	24	10	5	15	6.2	
Richmond	144	145	153	29.95	30.11	- .01	47.8	- 1.0	67	8	56	30	30	40	29	....	....	....	4.64	+ 2.2	12	6,221	n.	36	w.	26	12	6	12	5.6	T.
Wytheville	2,293	40	47	27.68	30.12	- .01	41.6	- 1.4	66	21	49	21	15	34	29	37	34	83	3.27	+ 0.2	11	4,474	w.	28	w.	26	11	5	14	5.8	2.7
S. Atlantic States.							53.5	- 0.6										78	3.23	+ 0.4										5.4	
Asheville	2,255	53	75	27.78	30.14	.00	44.2	- 0.9	71	21	54	23	30	35	36	39	35	78	3.00	- 0.3	12	6,075	nw.	40	se.	23	13	5	12	5.2	T.
Charlotte	773	68	76	29.27	30.12	- .01	48.4	- 2.0	73	9	57	30	30	40	32	42	36	70	4.61	+ 1.8	11	4,907	ne.	28	w.	6	10	7	13	5.6	
Hatteras	11	12	47	30.06	30.08	- .03	54.8	- 1.9	72	10	60	41	13	49	20	52	50	88	4.28	- 0.4	14	11,575	ne.	58	w.	6	11	9	10	5.2	
Raleigh	376	71	79	29.70	30.11	- .02	49.6	- 0.6	76	9	58	30	25	41	28	43	38	72	5.29	+ 2.9	10	4,432	n.	27	nw.	26	13	6	11	5.1	T.
Wilmington	78	81	91	30.02	30.11	- .01	58.8	- 0.3	76	22	63	32	14	45	29	48	45	79	2.49	0.0	11	5,554	n.	26	nw.	24	10	9	11	5.3	
Charleston	48	14	92	30.05	30.10	- .02	58.0	- 0.1	78	21	66	38	14	50	26	52	48	79	1.22	- 1.6	10	7,548	n.	35	w.	6	8	14	8	5.4	
Columbia, S. C.	351	41	57	29.73	30.12	.00	52.4	- 1.4	75	9	62	30	14	43	31	46	41	75	4.04	+ 1.8	10	4,755	ne.	28	sw.	2	11	8	11	5.5	
Augusta	180	89	97	29.91	30.11	- .02	53.3	- 0.6	76	9	63	29	15	44	33	48	44	81	3.84	+ 0.9	11	4,123	nw.	34	w.	6	13	6	11	4.9	
Savannah	65	81	89	30.04	30.11	- .01	58.2	+ 0.7	79	21	67	35	14	50	28	51	48	77	1.56	- 0.8	9	5,192	n.	30	w.	6	9	5	16	6.1	
Jacksonville	43	101	129	30.04	30.09	- .01	62.2	+ 0.9	83	22	70	43	14	54	25	56	54	81	1.96	- 0.2	9	5,954	n.	26	nw.	6	11	7	12	5.7	
Florida Peninsula.							72.0	+ 1.6										80	1.50	- 0.9										4.4	
Jupiter	28	10	48	30.02	30.04	- .01	72.8	+ 1.2	85	11	79	54	7	67	20	67	65	81	2.10	- 1.0	11	7,702	se.	24	se.	18	1	22	7	6.1	
Key West	22	10	53	30.00	30.02	.00	76.2	+ 1.9	84	10	81	67	7	72	12	70	67	79	1.49	- 0.9	7	6,772	ne.	26	nw.	6	17	8	5	3.9	
Sand Key	25	41	71	29.98	30.01	- .01	75.7	......	82	24	78	68	7	73	9	....	....	....	0.50	- 1.8	6	10,995	ne.	39	n.	13	14	12	4	4.2	
Tampa	35	79	96	30.04	30.08	.00	67.1	+ 1.7	83	21	76	44	14	58	28	60	57	80	1.89	+ 0.2	9	5,206	ne.	24	sw.	29	17	7	6	3.0	
East Gulf States.							54.2	- 1.5										73	5.76	+ 2.2										5.4	
Atlanta	1,174	190	216	28.86	30.12	- .01	50.0	- 1.9	73	9	58	29	14	43	26	43	37	68	5.99	+ 2.6	13	8,944	nw.	50	nw.	6	13	6	11	4.8	
Macon	370	55	66	29.71	30.12	- .01	52.9	- 0.4	76	9	62	29	15	45	33	....	....	....	4.52	+ 1.4	11	3,103	nw.	21	w.	6	12	3	15	5.4	
Thomasville	273	8	58	29.81	30.11	- .01	57.2	- 1.3	81	18	68	32	14	46	39	50	48	83	3.52	+ 0.9	8	3,594	nw.	18	nw.	6	10	3	17	5.9	
Pensacola	56	79	96	30.05	30.11	.00	58.6	- 1.0	76	8	66	35	18	51	23	....	....	....	3.39	- 0.4	11	7,187	n.	42	se.	17	8	7	15	5.5	
Anniston	741	9	58	29.34	30.15	+ .03	49.2	- 2.7	76	9	60	23	14	39	36	....	....	....	6.54	+ 3.1	14	4,298	n.	30	se.	17	12	5	13	5.8	
Birmingham	700	136	144	29.36	30.14	+ .02	51.6	- 2.5	75	9	60	26	14	41	30	45	40	72	5.22	+ 1.8	13	5,448	n.	39	se.	20	14	7	9	4.8	
Mobile	57	98	106	30.05	30.11	.00	57.6	+ 0.1	75	8	66	35	13	49	26	51	46	72	9.90	+ 6.2	10	5,263	n.	27	se.	17	12	7	11	5.6	
Montgomery	223	100	112	29.88	30.14	+ .02	54.0	- 1.7	77	9	63	29	14	45	33	48	42	72	8.75	+ 5.6	12	4,618	n.	23	se.	17	10	9	11	4.5	T.
Meridian	375	84	93	29.73	30.14	+ .02	51.2	- 2.0	77	8	62	23	14	41	36	45	41	77	4.79	+ 0.6	9	3,720	n.	23	se.	20	16	4	10	4.5	
Vicksburg	247	62	74	29.86	30.15	+ .03	54.6	- 1.3	79	1	63	29	13	46	28	47	41	67	5.80	+ 1.6	9	4,363	n.	26	e.	17	12	8	10	6.2	
New Orleans	51	88	121	30.05	30.11	+ .01	57.8	- 1.7	80	8	66	37	13	52	20	52	48	72	4.96	+ 1.2	9	7,051	ne.	34	se.	17	9	7	14	5.2	
West Gulf States.							53.8	- 2.1										73	6.24	+ 2.8										5.1	
Shreveport	249	77	84	29.88	30.16	+ .05	53.0	- 2.3	79	8	63	24	13	44	32	46	40	69	6.41	+ 2.3	8	4,163	n.	24	ne.	10	13	9	8	4.5	T.
Bentonville	1,303	11	44	28.74	30.13	+ .02	45.6	- 1.1	75	7	57	15	13	34	38	....	....	....	2.32	- 0.7	5	3,773	sw.	24	sw.	20	17	3	10	4.2	T.
Fort Smith	457	79	94	29.65	30.14	+ .03	49.4	- 0.5	77	7	60	19	13	39	35	42	37	70	2.53	- 0.8	6	4,639	sw.	36	sw.	20	13	9	8	4.1	T.
Little Rock	357	139	147	29.77	30.16	+ .04	50.6	- 0.9	76	8	59	25	13	42	28	44	37	66	8.75	+ 4.2	6	6,098	sw.	36	sw.	20	15	7	8	4.0	
Corpus Christi	20	48	53	30.09	30.11	+ .04	61.4	- 2.0	84	1	68	37	12	55	26	56	53	80	5.16	+ 2.8	14	6,920	n.	30	ne.	18	5	9	16	6.8	
Fort Worth	670	106	114	29.42	30.15	+ .05	52.4	- 2.7	78	7	62	21	13	43	32	....	....	....	5.81	+ 4.2	9	5,962	sw.	30	sw.	7	14	11	5	4.2	T.
Galveston	54	106	112	30.07	30.13	+ .04	60.0	- 2.9	78	8	65	36	13	55	23	55	51	76	6.33	+ 2.3	15	8,508	n.	46	e.	16	9	10	11	5.5	
Palestine	510	73	79	29.50	30.14	+ .03	54.2	- 2.7	78	8	62	24	13	46	29	47	43	74	10.07	+ 6.4	9	4,709	ne.	29	s.	17	14	3	13	5.1	T.
San Antonio	701	80	91	29.39	30.12	+ .04	56.4	- 2.8	80	8	64	29	13	49	29	50	47	74	6.79	+ 5.0	14	5,014	ne.	42	nw.	9	6	7	17	6.6	
Taylor	583	55	63	29.52	30.13	+ .05	54.6	- 3.1	79	8	63	26	13	46	29	....	....	....	8.21	+ 5.6	11	5,151	n.	30	n.	11	9	6	15	6.0	T.
Ohio Val. and Tenn.							44.0	- 1.2										73	3.26	- 0.2										5.7	
Chattanooga	762	106	112	29.32	30.15	+ .01	49.4	- 0.9	71	8	58	28	15	41	31	43	37	67	4.00	+ 0.4	12	4,641	nw.	33	se.	20	15	4	11	4.7	T.
Knoxville	1,004	93	100	29.05	30.13	.00	46.2	- 0.9	69	8	55	24	14	38	32	41	36	73	5.80	+ 2.2	13	3,385	sw.	27	w.	5	8	8	14	6.2	T.
Memphis	399	76	97	29.73	30.17	+ .05	51.1	- 0.3	74	8	59	28	12	43	29	44	39	70	5.13	+ 0.5	8	6,194	sw.	44	sw.	20	17	3	10	4.2	
Nashville	546	79	91	29.56	30.16	+ .04	47.8	- 0.9	74	8	57	25	14	39	32	41	36	69	4.39	+ 0.5	11	3,838	w.	34	se.	20	16	2	12	5.0	T.
Lexington	989	75	102	29.04	30.14	+ .02	42.2	- 2.5	67	8	50	25	18	35	26	....	....	....	2.67	- 0.8	9	7,462	nw.	37	s.	1	8	8	14	6.1	0.1
Louisville	525	111	132	29.54	30.13	+ .01	44.1	- 2.2	69	8	52	28	15	36	26	38	32	67	3.13	- 1.0	8	5,433	sw.	32	se.	20	11	8	11	5.3	T.
Evansville	431	72	82	29.64	30.12	.00	45.1	- 0.2	66	5	53	27	12	37	29	....	....	....	3.88	- 0.2	8	4,884	n.	38	sw.	20	11	12	7	4.5	T.
Indianapolis	822	154	164	29.20	30.11	+ .01	40.0	- 1.6	58	5	48	20	13	33	23	35	30	73	2.52	- 1.0	7	6,534	nw.	46	s.	20	11	8	11	5.3	1.4
Cincinnati	628	152	160	29.43	30.13	+ .01	42.8	- 1.8	63	8	50	24	30	35	24	37	32	69	1.97	- 1.2	10	5,013	w.	33	se.	20	13	5	12	5.3	T.
Columbus	824	178	224	29.20	30.10	- .01	40.2	- 1.2	59	8	47	24	15	33	23	36	31	75	1.68	- 1.4	9	8,584	nw.	40	w.	2	7	7	16	6.5	T.
Pittsburg	842	336	352	29.16	30.09	- .01	41.0	- 1.9	64	1	48	24	30	35	24	36	32	73	1.59	- 1.0	10	7,788	w.	43	nw.	7	5	11	14	6.6	0.4
Parkersburg	638	77	84	29.44	30.11	- .01	42.1	- 1.1	64	21	50	22	30	34	28	37	34	79	1.73	- 1.1	9	4,348	w.	31	se.	20	7	8	15	6.7	T.
Elkins	1,940	41	50	28.01	30.12	.00	39.4	- 0.2	66	21	48	17	30	31	32	35	32	82	3.84	+ 1.0	17	3,191	w.	24	w.	26	5	8	17	7.4	T.
Lower Lake Region.							38.5	- 0.4										78	2.12	- 0.9										7.3	
Buffalo	767	178	206	29.18	30.02	- .03	39.0	- 0.2	59	1	44	25	30	34	18	36	32	78	2.67	- 0.7	12	11,656	w.	60	sw.	13	1	12	17	7.5	0.3
Canton	448	10	71	29.52	30.01	......	33.8	- 0.1	59	1	40	7	30	28	30	....	....	....	2.98	- 0.4	11	8,609	sw.	49	sw.	21	2	8	20	7.9	5.4
Oswego	335	76	91	29.64	30.02	- .03	38.5	- 0.6	58	1	44	*25	12	33	23	36	33	81	3.30	- 0.1	12	8,403	s.	36	nw.	7	1	6	23	8.4	1.1
Rochester	523	81	102	29.45	30.04	- .01	38.8	+ 0.9	62	1	44	24	16	34	22	35	31	79	3.42	+ 0.7	13	6,340	sw.	34	nw.	7	2	8	20	7.9	2.2
Syracuse	597	97	113	29.39	30.04	- .02	37.9	- 0.8	57	1	43	23	12	33	17	....	....	....	2.25	- 0.4	14	7,377	s.	47	s.	2	3	8	19	7.7	5.3
Erie	713	92	102	29.26	30.04	- .02	40.2	- 0.9	58	1	45	22	15	35	18	36	31	72	1.05	- 2.6	10	9,327	sw.	55	se.	20	6	6	18	7.3	4.1
Cleveland	762	190	201	29.23	30.06	- .01	39.6	- 0.8	56	2	45	25	15	34	21	35	30	71	1.11	- 1.6	7	10,748	se.	52	nw.	6	5	10	15	6.8	1.3
Sandusky	629	62	70	29.38	30.08	.00	40.0	- 0.8	56	5	46	26	25	34	24	....	....	....	1.38	- 1.4	6	6,112	sw.	32	n.	6	8	7	15	6.1	0.1
Toledo	628	207	246	29.38	30.08	+ .01	39.2	- 0.5	56	8	46	24	14	33	23	35	31	76	1.63	- 1.0	9	10,466	sw.	53	s.	21	11	7	12	5.8	T.
Detroit	730	218	258	29.25	30.06	.00	38.2	- 0.4	54	2	44	21	14	32	19	36	34	86	1.46	- 1.2	10	10,213	w.	50	sw.	21	4	7	19	7.3	2.5
Upper Lake Region.							35.1	+ 1.0										77	1.74	- 0.7										6.7	
Alpena	609	13	92	29.33	30.01	.00	34.2	+ 0.5	52	2	40	16	16	28	25	31	28	82	1.85	- 0.7	14	7,724	w.	46	se.	20	3	9	18	7.6	3.6
Escanaba	612	40	82	29.34	30.03	.00	34.0	+ 2.3	48	1	40	12	14	28	26	30	25	72	1.50	- 0.8	7	7,459	nw.	27	n.	2	9	7	14	6.1	1.1
Grand Haven	632	54	92	29.35	30.05	+ .01	37.2	- 0.8	52	20	43	21	16	31	21	34	30	78	2.18	- 0.4	13	9,414	w.	48	sw.	21	5	10	15	7.0	1.3

TABLE I.—*Climatological data for U. S. Weather Bureau stations, November, 1907*—Continued.

Stations.	Elevation of instruments: Barometer above sea level, feet.	Elevation of instruments: Thermometers above ground.	Elevation of instruments: Anemometer above ground.	Pressure, in inches: Actual, reduced to mean of 24 hours.	Pressure, in inches: Sea level, reduced to mean of 24 hrs.	Pressure, in inches: Departure from normal.	Temperature of the air, in degrees Fahrenheit: Mean max. + mean min. ÷ 2.	Temperature: Departure from normal.	Temperature: Maximum.	Temperature: Date.	Temperature: Mean maximum.	Temperature: Minimum.	Temperature: Date.	Temperature: Mean minimum.	Temperature: Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches: Total.	Precipitation: Departure from normal.	Precipitation: Days with .01, or more.	Wind: Total movement, miles.	Wind: Prevailing direction.	Wind: Maximum velocity: Miles per hour.	Wind: Maximum velocity: Direction.	Wind: Maximum velocity: Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
Up. Lake Reg—Cont.																															
Grand Rapids	707	121	162	29.27	30.05	.00	37.6	− 0.5	53	1	44	20	16	31	21	34	31	81	2.18	− 0.4	10	7,595	w.	40	se.	20	3	8	19	7.5	T.
Houghton	668	66	74	29.25	29.99	− .03	32.6	+ 1.1	55	17	38	17	30	27	30	.....	.....	....	2.47	− 0.3	14	4,995	nw.	26	w.	9	4	9	17	7.5	13.6
Marquette	734	77	116	29.19	30.01	− .01	33.1	− 1.2	52	1	38	16	14	28	23	30	25	75	2.50	− 0.3	13	8,547	w.	39	sw.	12	3	11	16	7.2	16.7
Port Huron	638	70	120	29.32	30.04	− .01	36.8	0.0	56	1	43	17	14	30	20	34	31	81	1.48	− 1.2	9	8,906	sw.	37	se.	20	6	7	17	6.9	0.3
Sault Sainte Marie	614	40	61	29.30	30.01	.00	31.8	+ 1.1	48	1	37	12	14	27	20	30	27	84	2.19	− 0.7	16	7,453	se.	36	w.	8	2	5	23	8.6	7.6
Chicago	823	140	310	29.17	30.08	+ .01	41.0	+ 1.3	56	27	47	25	14	35	17	36	31	71	1.92	− 0.6	4	10,520	nw.	52	sw.	20	12	10	8	4.6	3.0
Milwaukee	681	122	139	29.33	30.08	+ .03	37.6	+ 1.5	53	18	43	18	14	32	19	33	28	71	0.85	− 1.1	7	7,303	w.	42	e.	20	14	8	8	4.7	1.8
Green Bay	617	49	86	29.35	30.03	− .01	34.9	+ 2.4	51	1	42	12	14	28	25	30	26	73	1.29	− 0.7	5	7,303	sw.	29	w.	9	6	12	12	6.4	T.
Duluth	1,133	11	47	28.77	30.02	− .02	30.3	+ 1.0	51	23	37	5	14	24	22	27	23	77	0.53	− 1.0	6	8,986	nw.	41	ne.	27	11	4	15	5.9	1.0
North Dakota.							**29.9**	**+ 5.3**										**76**	**0.16**	**− 0.6**										**4.9**	
Moorhead	940	8	57	29.03	30.08	+ .01	29.8	+ 5.4	53	6	40	0	14	20	32	26	24	86	0.11	− 0.9	2	6,154	nw.	32	nw.	8	9	8	13	5.7	1.3
Bismarck	1,674	8	57	28.27	30.12	+ .05	32.0	+ 6.0	63	6	45	5	14	19	41	26	21	71	0.36	− 0.3	2	7,048	nw.	40	nw.	8	23	5	2	2.8	3.6
Devils Lake	1,482	11	44	28.41	30.03	− .03	27.0	+ 4.4	55	6	38	− 7	15	16	34	23	20	79	0.16	− 0.8	4	8,036	nw.	42	w.	8	11	8	11	5.1	1.6
Williston	1,875	14	56	28.03	30.07	+ .01	30.8	+ 5.6	64	5	45	1	14	17	46	24	18	66	0.02	− 0.6	1	7,198	s.	42	nw.	9	6	14	10	6.2	T.
Upper Miss. Valley.							**39.0**	**+ 1.2**										**72**	**1.52**	**− 0.6**										**4.3**	
Minneapolis	.....	102	208	.....	.....	.....	34.6	.....	56	1	41	11	14	28	23	.....	.....	...	0.76	− 0.4	5	8,800	nw.	35	nw.	8	12	6	12	5.0	0.3
St. Paul	837	171	179	29.13	30.06	.00	34.4	+ 3.5	56	1	41	12	14	28	25	30	24	68	1.08	− 0.2	5	7,758	nw.	35	nw.	27	13	6	11	5.2	0.3
La Crosse	714	71	87	29.28	30.07	− .00	35.4	+ 1.6	52	1	42	13	14	29	25	.....	.....	....	1.56	0.0	6	5,241	s.	29	n.	2	10	10	10	5.4	2.3
Madison	974	70	78	28.99	30.07	+ .01	35.7	+ 1.5	51	1	42	15	14	29	22	31	28	78	1.22	− 0.6	4	7,150	nw.	29	nw.	2	13	10	7	4.5	1.0
Charles City	1,015	8	58	28.99	30.11	+ .03	34.0	+ 1.0	54	4	43	8	14	25	29	29	27	84	0.82	− 0.6	4	5,448	nw.	34	w.	9	9	12	9	5.1	1.5
Davenport	606	71	79	29.43	30.10	+ .02	38.8	+ 1.3	57	18	47	19	14	30	26	23	28	71	1.08	− 0.7	3	4,886	nw.	24	nw.	5	17	7	6	3.5	0.3
Des Moines	861	84	101	29.19	30.12	+ .04	38.6	+ 1.8	59	7	48	17	16	29	30	33	28	72	1.12	− 0.4	4	5,220	nw.	31	nw.	5	9	14	7	5.0	3.0
Dubuque	698	100	117	29.34	30.11	+ .04	37.1	+ 1.1	55	1	45	18	14	29	27	32	28	74	1.29	− 0.5	6	4,657	nw.	24	nw.	5	13	9	8	4.3	2.1
Keokuk	614	64	77	29.44	30.14	+ .05	41.1	+ 1.7	61	4	50	21	15	32	28	34	28	69	1.17	− 0.7	3	4,657	nw.	32	nw.	5	20	7	3	3.1	T.
Cairo	356	87	93	29.76	30.15	+ .03	46.9	0.0	70	8	55	26	18	39	30	40	34	67	4.43	+ 0.4	7	6,107	n.	39	sw.	20	14	6	10	4.4	T.
La Salle	536	56	64	29.53	30.12	+ .04	38.4	+ 0.6	56	27	47	18	15	30	27	.....	.....	....	1.55	− 1.1	5	5,162	w.	36	sw.	20	18	3	9	4.1	1.6
Peoria	609	11	45	29.44	30.12	+ .03	38.3	+ 0.8	60	5	49	14	16	28	32	32	28	75	1.68	− 1.0	4	5,199	nw.	38	sw.	20	14	11	5	3.6	T.
Springfield, Ill.	644	10	92	29.41	30.12	+ .02	41.5	+ 0.8	61	25	50	22	11	32	26	35	29	69	1.87	− 0.8	4	6,147	nw.	34	sw.	20	17	8	5	3.4	T.
Hannibal	534	75	109	29.53	30.12	+ .03	41.0	+ 0.5	63	4	52	20	15	39	30	.....	.....	....	1.22	− 0.7	2	5,772	nw.	36	sw.	20	16	10	4	4.1	T.
St. Louis	567	208	217	29.50	30.12	+ .02	44.4	+ 1.0	66	25	52	23	11	37	25	33	32	65	1.89	− 1.0	5	7,487	nw.	38	nw.	5	18	5	7	3.4	0.1
Missouri Valley.							**40.0**	**+ 2.6**										**63**	**0.70**	**− 0.5**										**4.0**	
Columbia, Mo.	784	11	84	29.30	30.15	+ .06	41.7	− 0.7	66	7	53	19	11	30	33	.....	.....	....	1.19	− 1.1	2	5,394	nw.	39	nw.	30	14	7	9	4.2	T.
Kansas City	963	116	181	29.13	30.19	+ .10	44.4	+ 2.9	69	7	53	20	14	36	28	37	30	62	1.32	− 0.5	3	8,242	nw.	43	n.	30	17	7	6	3.3	T.
Springfield, Mo	1,324	98	104	28.72	30.14	+ .04	45.1	+ 0.7	76	7	54	18	13	36	29	38	32	69	2.41	− 0.2	5	6,325	nw.	35	sw.	20	18	6	6	3.2	T.
Iola	984	40	47	29.09	30.16	+ .07	44.1	+ 1.1	73	3	55	19	11	33	33	.....	.....	....	1.55	+ 0.2	3	4,476	nw.	30	n.	30	14	9	7	4.2	T.
Topeka	.....	85	89	.....	.....	.....	43.1	+ 1.4	70	6	54	20	14	32	32	.....	.....	....	1.14	− 0.1	3	5,405	nw.	32	nw.	10	16	8	6	3.4	T.
Lincoln	1,189	11	84	28.84	30.15	+ .07	40.6	+ 2.6	67	6	51	16	14	30	32	33	26	63	0.25	− 0.6	2	7,228	s.	42	nw.	10	20	5	5	3.2	T.
Omaha	1,105	115	121	28.93	30.14	+ .06	40.9	+ 3.2	64	6	49	21	14	33	27	34	27	62	0.46	− 0.6	4	6,213	nw.	37	nw.	30	13	10	7	4.4	0.2
Valentine	2,598	47	54	27.37	30.16	+ .08	34.6	+ 0.9	69	6	50	− 2	12	20	46	28	20	61	0.03	− 0.7	2	7,471	nw.	48	nw.	27	19	6	5	3.8	0.3
Sioux City	1,135	96	164	28.88	30.13	+ .05	38.0	+ 3.7	62	6	48	12	14	28	32	.....	.....	....	0.05	− 0.9	2	8,789	nw.	44	nw.	30	13	10	7	4.3	0.3
Pierre	1,572	70	75	28.43	30.14	+ .06	36.8	+ 5.2	65	6	49	6	12	24	45	29	20	56	T.	− 0.4	0	6,154	nw.	39	nw.	9	15	8	7	4.2	T.
Huron	1,306	56	67	28.70	30.14	+ .06	33.6	+ 6.2	64	6	47	3	12	20	47	27	20	66	T.	− 0.6	0	7,013	nw.	36	nw.	9	10	12	8	5.2	T.
Yankton	1,233	49	57	28.79	30.14	+ .06	37.6	+ 4.1	63	6	49	11	14	26	42	.....	.....	....	0.01	− 0.8	1	6,132	nw.	31	nw.	27	10	7	13	5.2	0.1
Northern Slope.							**35.1**	**+ 3.4**										**68**	**0.36**	**− 0.5**										**4.2**	
Havre	2,505	11	44	27.37	30.05	+ .02	36.7	+ 6.1	64	6	50	0	11	24	38	31	26	71	0.04	− 0.7	2	7,858	sw.	36	sw.	22	16	9	5	3.9	0.2
Miles City	2,371	26	48	27.55	30.16	+ .09	37.8	+ 6.9	70	6	50	2	11	25	42	31	27	74	0.04	− 0.6	2	4,125	s.	30	nw.	9	13	16	1	3.5	0.2
Helena	4,110	8	56	25.88	30.16	+ .10	38.4	+ 5.7	59	1	47	20	27	30	25	32	24	57	0.13	− 0.6	2	4,608	sw.	36	sw.	4	10	9	11	5.5	0.5
Kalispell	2,962	8	34	27.02	30.15	+ .03	35.9	+ 3.9	56	4	45	14	18	27	31	32	28	80	0.50	− 1.4	6	2,998	w.	25	sw.	26	6	10	14	6.2	0.4
Rapid City	3,234	46	50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cheyenne	6,088	56	64	24.05	30.18	+ .11	34.0	− 0.9	64	6	47	0	12	21	48	27	19	59	0.59	+ 0.2	3	6,705	nw.	36	w.	24	16	8	6	3.8	7.2
Lander	5,372	26	36	24.71	30.22	+ .12	31.4	+ 2.7	63	5	47	3	19	16	47	25	19	65	0.49	− 0.1	2	1,988	ne.	40	sw.	26	15	11	4	3.7	4.9
Sheridan	3,790	5	...	26.16	30.18	.....	34.1	.....	69	6	49	3	11	19	49	.....	.....	....	0.58	.....	3	.....	sw.	.....	.....	...	17	7	6	3.8	3.8
Yellowstone Park	6,200	11	48	23.95	30.23	+ .12	30.0	+ 0.7	53	6	39	11	19	21	33	25	19	64	0.81	− 0.6	8	5,495	s.	28	sw.	26	10	17	3	4.6	10.8
North Platte	2,821	11	51	27.19	30.20	+ .12	36.8	+ 1.7	74	6	52	1	12	22	46	28	23	71	0.31	− 0.1	3	5,232	w.	32	n.	20	18	7	5	3.1	2.6
Middle Slope.							**42.4**	**+ 0.6**										**65**	**0.42**	**− 0.5**										**3.4**	
Denver	5,291	129	136	24.80	30.18	+ .12	38.7	− 0.5	72	6	52	9	12	25	42	30	22	59	0.40	− 0.1	2	4,547	s.	19	n.	18	17	9	4	3.3	7.5
Pueblo	4,685	80	86	25.37	30.15	+ .10	39.1	− 0.2	73	6	53	10	11	25	49	30	21	55	0.04	− 0.3	3	3,729	nw.	30	nw.	6	20	8	2	2.5	0.8
Concordia	1,398	42	50	28.66	30.18	+ .10	42.0	+ 2.1	67	6	54	16	14	30	35	35	30	72	0.21	− 0.7	2	4,252	nw.	26	nw.	10	16	10	4	3.2	T.
Dodge	2,509	44	54	27.52	30.19	+ .12	42.0	+ 1.5	75	6	56	7	12	28	41	33	27	66	0.17	− 0.4	2	5,099	n.	28	se.	23	17	10	3	3.2	0.4
Wichita	1,358	78	84	28.72	30.18	+ .10	44.9	+ 1.1	75	6	56	17	11	34	33	33	28	66	0.79	− 0.4	2	4,652	n.	28	n.	30	12	13	5	4.0	T.
Oklahoma	1,214	10	47	28.85	30.16	+ .08	47.4	− 0.5	74	6	58	18	12	37	32	40	35	72	0.91	− 1.3	4	8,324	s.	36	n.	10	16	6	8	4.3	T.
Southern Slope.							**48.1**	**− 2.8**										**73**	**2.02**	**+ 0.8**										**5.9**	
Abilene	1,738	45	54	28.32	30.16	+ .09	49.8	− 2.8	77	7	59	22	12	41	30	44	40	76	2.06	+ 0.8	10	4,275	s.	27	w.	20	8	10	12	5.7	0.3
Amarillo	3,676	10	49	26.34	30.13	+ .08	43.4	− 0.4	74	6	56	16	12	31	38	36	32	76	0.66	− 0.5	5	6,725	s.	30	s.	27	14	9	7	5.0	4.0
Del Rio	944	8	57	29.12	30.12	+ .07	54.9	− 4.4	77	9	64	30	13	46	34	.....	.....	....	4.02	+ 2.2	14	4,451	se.	28	ne.	10	4	9	17	7.2	
Roswell	3,578	9	57	26.41	30.10	+ .07	44.4	− 3.7	75	7	57	21	13	32	41	39	36	81	1.36	+ 0.2	7	3,345	n.	24	w.	20	9	12	9	5.5	0.5
Southern Plateau.							**48.8**	**− 0.2**										**61**	**0.32**	**− 0.6**										**2.9**	
El Paso	3,762	10	110	26.26	30.08	+ .08	49.9	− 1.0	74	7	60	30	12	40	32	42	37	68	0.73	+ 0.1	6	5,694	nw.	36	w.	20	11	9	10	5.3	
Santa Fe	7,013	33	39	23.28	30.14	+ .11	37.0	− 1.2	62	5	48	15	24	26	33	29	24	69	0.36	− 0.4	5	5,568	ne.	26	ne.	24	20	8	2	2.7	1.7
Flagstaff	6,907	8	57	23.38	30.06	+ .04	35.4	+ 0.8	62	3	48	10	21	22	38	30	25	72	0.50	− 0.9	5	4,012	e.	26	sw.	17	19	4	7	3.5	8.2
Phoenix	1,108	50	56	28.85	30.02	+ .04	59.8	+ 1.1	85	6	73	34	19	47	37	49	40	55	0.21	− 0.8	3	2,501	e.	22	e.	12	22	6	2	2.2	
Yuma	141	16	46	29.86	30.01	+ .03	62.6	+ 0.7	88	4	77	34	21	48	35	50	39	50	0.06	− 0.3	2	4,059	n.	33	n.	15	23	5	2	1.6	
Independence	3,910	11	42	26.10	30.13	+ .08	47.8	− 1.4	70	11	61	22	19	34	38	37	28	53	T.	− 1.0	0	4,203	nw.	28	n.	18	22	5	3	2.4	
Middle Plateau.							**39.9**	**+ 0.9**										**62**	**0.34**	**− 0.6**										**3.2**	
Reno	4,532	56	63	25.59	30.21	− .10	42.3	+ 1.3	66	1	56	22	30	28	37	35	30	69	0.07	− 1.0	2	2,66[illegible]	w.	25	sw.	26	18	9	3	3.1	0.1
Tonopah	6,089	12	20	24.16	30.22	......	42.2	+ 3.7	59	5	50	20	19	34	23	33	22	48	0.01	− 0.9	1	5,126	w.	34	nw.	17	18	11	1	3.3	0.3
Winnemucca	4,344	18	56	25.76	30.24	+ .10	38.8	+ 1.3	67	1	54	16	16	23	43	31	24	65	0.48	− 0.3	3	4,003	ne.	32	sw.	20	15	5	10	4.1	4.0
Modena	5,479	10	43	24.70	30.14	+ .06	38.0	− 1.0	64	3	53	13	22	23	43	31	25	67	0.12	− 0.8	3	5,788	w.	28	w.	19	20	4	6	3.3	0.8
Salt Lake City	4,366	105	110	25.74	30.17	+ .05	41.4	+ 1.0	62	26	50	24	22	32	27	35	29	62	0.50	− 0.9	3	2,947	se.	30	n.	26	20	5	5	3.1	3.0
Durango	6,546	18	56	23.70	30.14	+ .08	36.8	− 0.4	64	5	51	12	22	23	36	28	22	66	1.08	− 0.1	4	3,857	nw.	21	w.	20	19	6	5	2.9	9.2
Grand Junction	4,608	43	51	25.50	30.14	+ .06	40.1	+ 0.2	65	9	53	17	24	27	33	31	22	54	0.10	− 0.5	3	2,467	e.	15	se.	17	19	7	4	2.7	T.
Northern Plateau.							**41.6**	**+ 2.9**										**69**	**0.80**	**− 0.5**										**5.3**	
Baker City	3,471	48	58	26.58	30.23	+ .07	38.0	+ 3.1	57	1	48	23	21	28	30	33	29	72	0.40	− 0.8	8	4,964	s.	27	s.	23	11	11	8	4.7	1.4
Boise	2,739	78	86	27.34	30.25	+ .08	42.3	+ 2.7	65	1	51	27	12	33	27	36	29	63	1.05	+ 0.2	9	3,471	se.	32	w.	1	10	10	10	5.3	0.7
Lewiston	757	10	51	29.37	30.19	+ .07	43.5	+ 2.6	62	5	52	24	12	35	29	.....	.....	....	0.70	− 0.6	6	3,571	e.	48	nw.	1	4	10	16	6.9	
Pocatello	4,477	46	54	25.63	30.24	+ .10	38.2	+ 1.9	61	6	48	22	30	28	34	32	24	61	0.21	− 0.3	6	4,798	se.	32	sw.	26	18	8	4	2.9	1.2
Spokane	1,929	101	110	28.08	30.18	+ .08	40.5	+ 3.2	59	29	48	26	18	33	25	37	34	79	1.37	− 0.9	12	4,498	s.	38	sw.	23	4	11	15	6.7	T.
Walla Walla †	1,000	71	79	29.09	30.18	+ .05	46.8	+ 3.9	69	1	56	29	27	38	28	48	38	72	1.68	− 0.5	10	4,532	s.	34	s.	23	10	12	8	5.1	
N. Pac. Coast Reg.							**47.7**	**+ 2.6**										**87**	**6.07**	**− 1.2**										**7.1**	
North Head	211	11	56	29.89	30.12	+ .07	50.0	+ 2.3	60	9	54	40	27	46	25	48	47	89	5.58	− 0.8	17	13,356	se.	74	s.	25	3	3	24	8.3	
Port Crescent	259	12	29	29.76	30.08	+ .08	44.4	+ 2.1	59	28	52	29	27	37	21	.....	.....	....	6.30	− 1.2	20	3,649	se.	22	s.	1	5	5	20	7.0	
Seattle	123	185	224	30.00	30.13	+ .09	48.0	+ 3.5	62	1	53	34	27	43	19	47	45	90	4.73	− 1.1	17	7,188	se.	51	s.	23	1	9	20	8.2	
Tacoma	213	113	120	29.90	30.13	+ .09	47.6	+ 3.5	65	1	53	32	27	42	21	.....	.....	....	5.48	− 3.0	16	4,746	w.	31	sw.	23	5	6	19	7.6	
Tatoosh Island	86	7	57	29.94	30.04	+ .07	48.9	+ 3.0	65	9	53	38	27	45	17	47	46	85	9.57	− 2.5	21	15,706	s.	72	s.	25	4	2	24	8.1	
Portland, Oreg.	153	68	106	29.99	30.15	+ .05	48.8	+ 3.2	66	9	56	34	27	42	22	46	44	84	6.51	0.0	15	4,626	sw.	36	sw.	23	8	5	17	6.3	
Roseburg	510	9	57	29.64	30.20	+ .08	46.1	+ 0.5	67	1	54	33	4	38	32	44	42	89	4.32	0.0	15	1,479	s.	22	nw.	1	10	14	6	4.6	

TABLE I.—*Climatological data for U. S. Weather Bureau stations, November, 1907*—Continued.

Stations.	Elevation of instruments: Barometer above sea level, feet.	Elevation of instruments: Thermometers above ground.	Elevation of instruments: Anemometer above ground.	Pressure, in inches: Actual, reduced to mean of 24 hours.	Pressure, in inches: Sea level, reduced to mean of 24 hrs.	Pressure, in inches: Departure from normal.	Temperature: Mean max. + mean min. ÷ 2.	Temperature: Departure from normal.	Temperature: Maximum.	Temperature: Date.	Temperature: Mean maximum.	Temperature: Minimum.	Temperature: Date.	Temperature: Mean minimum.	Temperature: Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation: Total.	Precipitation: Departure from normal.	Precipitation: Days with .01, or more.	Wind: Total movement, miles.	Wind: Prevailing direction.	Wind: Maximum velocity: Miles per hour.	Wind: Maximum velocity: Direction.	Wind: Maximum velocity: Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
Mid. Pac. Coast Reg.							54.6	+ 1.0										70	0.46	— 2.5										4.1	
Eureka	62	62	80	30.13	30.20	+ .09	51.0	0.0	67	1	57	38	23	45	19	49	48	89	2.38	— 3.3	10	3,201	n.	34	w.	1	5	13	12	6.3	
Mount Tamalpais	2,375	11	18	27.66	30.15	+ .06	53.9	......	71	9	60	39	17	48	21	45	36	56	0.13	— 2.3	5	11,900	nw.	58	nw.	19	20	4	6	3.0	
Point Reyes Light	490	7	18	29.57	30.09	......	54.6	......	72	5	59	46	23	50	22	....	....	....	0.23	......	5	14,378	n.	70	nw.	16	12	9	9	4.9	
Red Bluff	332	50	56	29.77	30.14	+ .03	54.6	+ 1.2	79	7	66	38	19	43	31	47	40	62	0.40	— 2.8	3	3,640	nw.	27	n.	18	12	9	9	4.1	
Sacramento	69	106	117	30.05	30.12	+ .03	55.6	+ 2.2	76	8	67	37	27	44	29	48	42	65	0.04	— 2.1	1	4,766	nw.	28	nw.	17	21	6	3	2.3	
San Francisco	155	200	204	29.96	30.13	+ .04	57.8	+ 2.3	78	8	65	45	27	51	26	51	47	76	0.04	— 2.4	3	3,460	w.	27	ne.	18	14	13	3	3.2	
San Jose	141	78	88	29.98	30.13	......	53.8	— 0.6	76	8	67	33	27	41	37	....	....	....	0.13	— 2.3	6	......	nw.	....	......	...	18	8	4	3.2	
Southeast Farallon	30	9	17	30.10	30.13	......	54.7	......	65	30	57	48	28	52	15	....	....	....	0.08	— 2.4	4	12,360	nw.	55	nw.	17	9	8	13	5.7	
S. Pac. Coast Reg.							59.6	+ 2.6										66	0.02	— 1.2										2.4	
Fresno	330	67	70	29.76	30.13	+ .07	55.4	+ 0.8	78	5	68	33	18	42	39	47	41	66	0.00	— 1.0	0	2,518	se.	24	nw.	17	25	5	0	1.9	
Los Angeles	338	116	123	29.66	30.03	+ .01	63.5	+ 5.1	86	29	75	44	27	52	35	52	44	57	T.	— 1.5	0	3,429	ne.	22	sw.	20	21	5	4	2.4	
San Diego	87	94	102	29.93	30.02	.00	61.2	+ 2.2	86	29	70	45	18	53	32	53	47	68	0.05	— 0.8	1	3,819	nw.	22	w.	17	26	4	0	2.1	
San Luis Obispo	201	47	54	29.88	30.10	+ .04	58.4	+ 2.1	86	29	71	37	19	45	45	50	45	71	0.01	— 1.7	1	3,608	n.	22	ne.	26	20	7	3	3.0	
West Indies.							78.4																								
Grand Turk	11	6	20	29.97	29.98	+ .03	78.3	......	88	*3	84	69	29	73	....	....	....	....	5.63	......	17	......	......	....	......	...	...	...	...	...	
San Juan	82	48	90	29.85	29.93	+ .03	78.6	......	87	4	84	70	29	74	14	73	71	80	4.97	—1.5	20	5,664	ne.	26	e.	29	11	15	4	4.0	
Panama.																															
Ancon	74	....	....	......	29.84	......	80.0	......	93	16	87	71	28	72	21	....	....	....	10.51	......	21	......	......	....	......	...	6	7	17	...	
Bas Obispo	40	....	....	......	29.85	......	78.0	......	89	17	84	67	28	72	20	....	....	....	9.85	......	22	2,600	nw.	36	se.	14	0	10	20	...	
Naos	......	....	....	......	29.84	......	80.5	......	91	9	87	72	5	74	17	....	....	....	4.75	......	19	5,006	nw.	34	ne.	27	1	11	18	...	
Christobal	......	....	....	......	29.85	......	78.4	......	85	15	83	71	5	74	13	....	....	....	15.37	......	28	5,369	se.	25	n.	6	6	11	13	...	

* More than one date. † Record incomplete.

TABLE II.—*Climatological record of cooperative observers, November, 1907.*

Stations.	Temperature (Fahrenheit.): Maximum.	Temperature (Fahrenheit.): Minimum.	Temperature (Fahrenheit.): Mean.	Precipitation: Rain and melted snow.	Precipitation: Total depth of snow.
Alabama.	°	°	°	*Ins.*	*Ins.*
Alaga	......	......	......	4.80	
Ashville	81	20	50.2	5.37	
Auburn	74	31	53.2	8.21	
Bermuda	76	26	55.0	8.81	
Boligee	79	20	51.7	3.70	T.
Bridgeport	......	......	......	5.30	T.
Camphill	79	25	52.6	8.31	
Cedar Bluff	......	......	......	6.46	
Citronelle	80[e]	28[e]	57.2[e]	......	
Clanton	78	21	51.4	8.06	
Cordova	79	19	50.0	5.48	
Cullinan	75	21	49.2	4.01	
Decatur	74	21	46.6	3.60	
Daphne	80	35	59.6	8.03	
Demopolis	......	......	......	4.72	
Eufaula	72	27	51.4	7.64	
Evergreen	80	27	55.2	7.18	
Flomaton	......	......	......	2.80	
Florence	76	21	48.8	4.63	
Fort Deposit	77	29	53.0	7.43	
Gadsden	76	24	50.4	5.28	
Good Water	82	30	56.0	5.98	
Greensboro	77	29	52.6	5.13	
Guntersville	......	......	......	4.70	
Hamilton	77	19	49.4	5.28	
Highland Home	79	28	55.1	9.10	
Letohatchee	......	......	......	4.24	
Livingston	78	21	50.7	4.07	
Lock No. 4	76	23	50.3	7.46	
Lucy	77[d]	22[d]	56.4[d]	5.70	
Madison Station	75	21	48.0	4.99	
Maplegrove	76	20	47.4	5.59	
Newbern	81	24	53.0	5.47	
Opelika	75	28	54.1	7.92	
Ozark	74	29	58.2	5.22	
Pushmataha	80	21	51.6	5.44	
Riverton	77	17	46.3	5.00	
Scottsboro	73	20	48.6	4.83	T.
Selma	80	25	51.8	7.96	
Spring Hill	79	31	57.4	8.22	
Talladega	78	20	51.6	6.73	
Thomasville	73	26	52.0	4.62	
Tuscaloosa	78	22	49.5	4.23	
Tuscumbia	75	21	48.0	4.53	
Tuskegee	80	29	54.1	8.67	
Union Springs	76	28	53.1	7.97	
Uniontown	79	25	53.4	4.98	
Valley Head	74	16	46.0	5.74	
Wetumpka	82	25	54.0	7.95	
Arizona.					
Allaire Ranch	......	......	......	1.67	
Arizona Canal Co. Dam	86	36	61.0	0.08	
Aztec	90	38	63.0	0.00	
Benson	80	29	51.3	1.30	
Bisbee	69[d]	29[d]	43.6[d]	2.93	T.

Stations.	Temperature (Fahrenheit.): Maximum.	Temperature (Fahrenheit.): Minimum.	Temperature (Fahrenheit.): Mean.	Precipitation: Rain and melted snow.	Precipitation: Total depth of snow.
***Arizona*—Cont'd.**	°	°	°	*Ins.*	*Ins.*
Bonita	......	......	......	2.04	2.0
Bowie	74	29	50.6	1.50	
Buckeye	85	30	58.7	0.11	
Casa Grande	90	29	59.9	0.00	
Cave Creek	87	38	60.4	0.16	
Chiarsons Mill	50	9	29.4	3.47	16.0
Clifton	......	......	......	1.14	T.
Cline	75	30	52.9	0.89	
Cochise *[1]	70	32	50.4	1.93	
Columbia	85	38	64.4	3.18	
Congress	76	34	57.4	1.42	2.0
Douglas	81	26	50.6	2.41	
Dudleyville	81	30	55.0	0.90	
Fish Creek	......	......	......	0.16	
Fort Apache	73	17	45.4	0.10	T.
Fort Huachuca	72	15	49.7	1.72	T.
Fort Mojave	86	36	61.4	0.07	
Fredonia	76	31	50.6	0.02	
Gila Bend	88	35	64.4	0.00	
Globe	75	30	52.0	0.82	
Grand Canyon	60	18	38.4	1.58	12.8
Greer	......	......	......	0.32	2.4
Holbrook	70	21	42.8	1.40	5.0
Huachuca Reservoir	......	......		4.78	
Intake	......	......	......	0.93	
Jerome	68	31	49.8	0.60	6.0
Keams Canyon	65	16	39.4	0.63	6.0
Kingman	79	22	52.6	0.05	
Maricopa	90	35	60.9	0.10	
Mesa	88	34	59.8	0.04	
Mohawk Summit	88	45	70.2	0.00	
Natural Bridge	......	......	......	1.09	
Paradise	80	26	46.6	1.74	3.0
Parker	92	30	61.6	0.19	
Phoenix (Ex. Farm)	85	32	58.8	0.46	
Picacho *[5]	85	41	63.5	0.39	
Pinal Ranch	......	......	......	1.55	0.5
Pinto	......	......	......	1.17	4.0
Prescott	72	29	49.8	0.63	1.5
Roosevelt	82	33	56.8	1.44	
St. Johns	68	14	41.4	0.37	2.3
St. Michaels	62	13	35.3	0.36	6.0
San Carlos	82	29	53.8	0.63	
San Simon	69	27	46.1	0.93	
Seligman	70	20	44.9	0.59	5.5
Sentinel	81	35	59.3	0.00	
Silverbell	84	37	59.0	1.25	
Tempe	89	33	60.0	0.04	
Thatcher	75	27	51.2	0.51	
Tombstone	70	31	49.8	2.68	
Tucson	85	30	58.1	0.78	
Upper San Pedro	79	24	49.8	1.50	
Vail *[5]	82	41	64.3	0.09	
Walnut Grove	......	......	......	0.30	2.0
Williams	82	10	41.0	0.92	9.6
Yarnell	......	......	......	1.36	10.0

Stations.	Temperature (Fahrenheit.): Maximum.	Temperature (Fahrenheit.): Minimum.	Temperature (Fahrenheit.): Mean.	Precipitation: Rain and melted snow.	Precipitation: Total depth of snow.
Arkansas.	°	°	°	*Ins.*	*Ins.*
Alicia	76	19	47.6	6.30	
Amity	79	13	50.0	8.73	T.
Arkadelphia	......	......	......	7.35	
Arkansas City	......	......	......	4.61	
Batesville	80	20	48.4	6.38	
Bee Branch	77[e]	20[e]	49.6[e]	6.30	
Benton	84	20	50.5	9.32	
Bergman	......	......	......	2.54	
Brinkley	78	19	49.2	6.06	
Camden	79	18	50.8	8.61	
Center Point	80	16	50.9	8.60	
Clarendon	......	......	......	6.18	
Conway	76	19	46.2	7.40	
Corning	76	20	47.9	5.83	T.
Des Arc	77[g]	22[g]	51.1[g]	7.65	
Dodd City	76	15	45.6	3.00	
Dutton	76	13	45.6	3.68	T.
Earl	77[i]	20[i]	......	4.20	
El Dorado	81	22	51.4	6.47	
England	79	19	51.3	6.60	
Eureka Springs	75	15	46.1	2.73	
Fayetteville	75	14	47.0	2.78	T
Forrest City	78	20	49.6	5.83	
Fulton	......	......	......	5.00	
Hardy	74	21	48.1	4.78	T.
Heber	80	18	47.2	7.76	T.
Helena	78	24	50.6	5.37	
Hope	79	16	52.0	8.04	
Hot Springs	75	14	47.6	8.80	
Huttig	81[d]	27[f]	52.7[e]	4.84	
Jonesboro	......	......	......	4.77	
La Crosse	75	17	48.4	4.41	
Lakefarm	81	17	50.5	5.91	
Lewisville	80[e]	16[e]	50.4[e]	6.58	
Lutherville	77	15	47.7	4.44	T.
Malvern	76	19	48.6	8.95	
Mammoth Spring	75	16	45.0	4.68	
Marked Tree	......	......	......	5.85	
Marvell	80	20	50.4	6.20	
Mena	75	16	49.5	4.48	
Montrose	79	20	51.8	4.45	
Mossville	71	15	47.1	4.43	
Mount Nebo	......	......	......	4.09	T.
Newport	78[e]	22[e]	50.2[e]	5.60	
Pine Bluff	78	19	49.0	7.50	
Pocahontas	76	20	48.6	6.19	
Pond	77	10	45.2	1.97	T.
Prescott	80	18	50.2	7.55	
Princeton	81	14	49.9	8.45	
Rogers	76	13	46.7	2.74	T.
Russelville	......	......	......	4.73	
Spielerville	81	19	49.6	4.02	T.
Stuttgart	82	18	49.3	6.03	
Texarkana	80[j]	22[i]	53.6[j]	4.90	
Warren	79	18	50.2	5.86	
Wiggs	77	11	48.2	9.12	

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
California.	°	°	°	*Ins.*	*Ins.*
Alturas	68	14	38.6	1.11	8.0
Auburn	78	42	58.8	0.00	
Azusa	85	34	59.6	0.01	
Bagdad	82	42	62.8	0.00	
Bakersfield	90	28	58.2	0.00	
Bear Valley	.....	.....	.....	0.50	0.8
Berkeley	70	42	55.0	0.08	
Bishop	76	18	47.3	0.00	
Blocksburg	76	28	47.5	2.54	
Blue Canyon	70	22	42.8	0.42	
Branscomb	75	29	48.2	2.49	
Brush Creek	72	28	47.0	0.53	
Butte Valley	.....	.....	.....	0.91	
Calexico	86	40	63.0	0.00	
Campbell	75	29	52.5	0.06	
Campo	.....	.....	.....	0.25	
Cedarville	62	16	37.6	0.71	5.0
Chico	74	29	54.0	0.14	
Claremont	88	37	60.6	0.06	
Cloverdale	83	34	55.4	0.34	
Colfax	80	38	60.4	0.13	
Colusa	78	26	50.9	0.00	
Crescent City	70	31	51.0	4.47	
Crockers	.....	.....	.....	T.	
Cuyamaca	58	25	41.9	1.31	
Delta	82	29	51.3	0.57	
Dobbins	88	36	59.2	0.22	
Durham	81	30	54.0	0.17	
El Cajon	88	33	59.5	0.62	
Electra	79	37	57.8	0.06	
Elmwood	75	29	53.7	0.10	
Elsinore	84	26	55.5	0.08	
Escondido	85	27	56.6	0.14	
Folsom	82	34	56.0	0.24	
Fordyce	.....	.....	.....	0.35	6.0
Fort Ross	73	38	54.4	0.95	
Georgetown	74	31	52.7	0.27	
Gold Run	78	32	55.2	0.20	
Greenville	68	19	41.8	0.60	
Hanford	80	30	54.6	0.00	
Healdsburg	83[f]	30[f]	56.7[f]	0.11	
Heber	92	36	63.8	0.02	
Hollister	80	29	54.6	0.03	
Idyllwild	69	19	46.2	1.11	4.0
Indio	92	37	64.8	0.05	
Iowa Hill	79	33	55.0	0.23	
Isabella	.....	.....	.....	T.	
Jamestown	73	29	53.2	0.00	
Jolon	.....	.....	.....	0.00	
Kennedy Gold Mine	.....	.....	.....	0.23	
Kentfield	.....	.....	.....	0.00	
Kernville	.....	.....	.....	0.00	
King City	75	32	56.4	0.00	
La Porte	71	21	44.4	0.64	1.0
Laytonville	.....	.....	.....	1.11	
Le Grande	72	30	51.8	0.00	
Lemoncove	81	33	57.2	T.	
Lick Observatory	65	32	49.6	0.18	
Livermore	82	33	56.1	0.04	
Lodi	73	30	52.3	0.09	
Lone Pine	70	22	47.1	T.	
Los Gatos	74	33	52.4	0.03	
Magalia	88	27	51.4	0.76	
Mammoth	92	38	66.0	0.00	
Marysville	83	28	56.0	T.	
Mena	86	35	60.6	0.05	
Mill Creek	80	20	51.6	0.27	
Mills College	.....	.....	.....	0.12	
Milo	.....	.....	.....	0.00	
Milton (near)	74	40	57.4	0.05	
Mojave	80	52	66.1	0.00	
Mokelumne Hill	75	39	56.2	0.26	
Mono Ranch	68	26	48.0	T.	
Montague	66	25	46.0	0.28	
Monterio	74	30	51.3	0.10	
Monumental	68	27	44.1	8.77	
Mount St. Helena	.....	.....	.....	0.64	
Napa	80	34	56.0	0.09	
Needles	.....	.....	.....	0.00	
Nevada City	85	25	50.6	0.38	
Newcastle	74	36	55.6	0.12	
Newman	75[e]	30[e]	54.4[e]	0.00	
Nimshew	78	28	51.2	0.53	
North Bloomfield	74	27	48.4	0.45	
Oakland	69	41	55.0	0.08	
Ojai Valley	89	32	58.8	0.03	
Orland	81	30	54.2	T.	
Orleans	76	30	54.8	3.09	
Oroville (near)	83	35	56.0	0.05	
Ozena	.....	.....	.....	0.00	
Palermo	82	30	53.8	0.25	
Pilot Creek	.....	.....	.....	0.28	
Pine Crest	82	48	62.8	T.	
Placerville	72	28	48.2	0.21	
Point Lobos	68	46	57.4	0.04	
Porterville	78	33	55.6	0.00	
Poway	84	27	57.0	0.48	
Quincy	65	18	39.8	0.70	
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Redding	78	33	54.2	0.33	
Redlands	83	36	59.4	0.24	
Reedley	78	31	53.9	0.00	
Represa	.....	.....	.....	0.31	
Rialto	87	40	65.5	0.26	
Riverside	84	33	58.2	0.02	
Rocklin	79	31	54.9	0.10	
Rohnerville	72	34	51.8	2.27	
Sacramento	70	34	53.0	0.05	
Salinas	78	33	55.5	0.00	
San Bernardino	87	31	58.8	0.10	
San Jacinto	85	30	57.2	0.11	
San Miguel Island	.....	.....	.....	0.00	
Santa Barbara	85	38	58.6	T.	
Santa Clara College	77	30	54.6	0.13	
Santa Cruz	81	33	55.0	0.00	
Santa Maria	80	36	56.9	0.00	
Santa Monica	87	40	59.4	T.	
Santa Rosa	80	28	53.5	0.13	
Shasta	88	31	59.8	0.06	
Sierra Madre	80	44	61.3	0.01	
Sisson	65	23	41.4	T.	
Stirling City	69	26	46.8	0.25	
Stockton	71	31	53.7	T.	
Storey	79	26	52.8	T.	
Summerdale	69	26	47.6	0.21	1.0
Summit	63	19	38.2	0.40	4.0
Susanville	59	23	40.2	0.47	
Tamarack	51	4	31.9	0.48	4.0
Towle	78	24	51.4	0.00	
Tulare	76	28	53.7	0.00	
Tustin (near)	.....	.....	.....	0.18	
Ukiah	79	26	50.8	0.36	
Upper Lake	81	30	51.9	0.16	
Upper Mattole	.....	.....	.....	3.52	
Vacaville	84	30	56.2	0.08	
Wasco	77	28	51.5	0.00	
Westpoint	.....	.....	.....	0.06	
West Saticoy	.....	.....	.....	0.00	
Wheatland	79	33	53.6	0.11	
Willows	80	32	54.1	0.02	
Woodleaf	.....	.....	.....	0.35	
Woodside	71	33	52.9	T.	
Yosemite	67	21	42.6	0.90	T.
Colorado.					
Akron	.....	.....	.....	1.00	6.0
Alamosa	62[i]	0[i]	29.4[i]	0.00	
Amethyst	65	− 6	28.2	0.19	1.9
Arriba	70	− 7	36.2	0.05	0.5
Ashcroft	57	− 4	26.1	0.23	3.5
Blaine	69	0	39.6	0.50	
Boulder	67	12	40.9	0.41	6.2
Breckenridge	56	− 4	26.2	T.	T.
Buena Vista	64	− 1	28.6	0.22	2.0
Canyon	72	12	42.7	0.33	3.3
Cascade	.....	.....	.....	1.21	16.5
Castle Rock	55	3	28.5	0.23	3.0
Cheesman	69	5	36.6	0.12	2.5
Cheyenne Wells	76	− 3	40.8	0.25	T.
Chromo	66	3	32.8	0.50	.....
Collbran	65[j]	7[j]	32.8[j]	0.20	2.2
Colorado Springs	65	6	36.4	0.29	2.2
Cope	72	− 1	38.0	0.42	5.5
Cripple Creek	.....	.....	.....	0.31	7.3
Delta	67	10	33.6	0.39	.....
Eads	73	0	38.2	0.33	T.
Eagle	65	0	31.2	0.04	0.5
Eureka	.....	.....	.....	0.28	3.0
Fort Collins	70	− 1	32.9	0.44	5.5
Fort Morgan	76	− 1	33.4	0.50	4.0
Frances	56	0	31.4	0.29	8.0
Fruita	65	11	36.8	0.08	0.1
Garnett	62[g]	1	27.6[d]	0.35	3.5
Gladstone	.....	.....	.....	0.49	8.0
Gleneyre	68	1	34.8	.....	.....
Grand Lake	.....	.....	.....	0.09	.....
Grand Valley	67	9	36.8	0.10	T.
Greeley	72[g]	2	33.4[d]	0.64	10.0
Gunnison	60	− 2	27.8	T.	T.
Hahns Peak	62	− 3	25.4	0.29	5.0
Hamps	71	6	36.0	0.20	3.5
Hoehne	77	5	36.7	0.48	6.5
Holly	79	5	39.4	0.90	.....
Idaho Springs	61	2	35.8	0.25	3.5
Kremlin	.....	.....	.....	0.07	1.0
Lake City	58	− 1	29.2	0.30	4.0
Lake Moraine	51	− 6	27.6	0.50	6.0
Lamar	75	6	41.4	0.22	.....
Laporte	.....	.....	.....	0.28	4.2
Las Animas	74	6	39.5	0.40	1.0
Lay	64	− 4	28.4	0.14	2.5
Leroy	72	3	35.6	0.66	6.8
Longs Peak	65	10	38.4	0.50	8.0
Lujane	62	13	36.8	0.18	2.0
Manassa	63	3	31.0	0.24	3.5
Mancos	65	2	35.6	1.46	12.0
Meeker	65	1	31.4	0.22	3.0
Montrose	59	10	34.1	T.	.....
Colorado—Cont'd.	°	°	°	*Ins.*	*Ins.*
Moraine	57	0	31.9	0.29	3.7
Nederland	.....	.....	.....	0.35	6.8
Pagoda	65	5	32.8	T.	.....
Pagosa Springs	65	1	33.0	0.54	8.5
Paonia	69	14	39.2	0.08	1.0
Platte Canyon	.....	.....	.....	0.55	3.5
Power House	62	7	34.9	0.26	8.5
Rangely	67	1	31.0	T.	T.
River Portal	56	12	33.0	0.14	T.
Rocky Ford	71	9	40.2	2.00	T.
Saguache	62[e]	6[e]	33.4[e]	0.30	4.0
Salida	64	2	34.0	0.75	7.0
San Luis	67	−10	32.1	0.65	6.0
Sapinero	57	1	29.0	0.40	4.4
Sheridan Lake	72	− 1	32.6	0.23	1.2
Silverton	60	− 8	28.2	0.56	6.5
Stonewall	.....	.....	.....	0.54	12.0
Terminal Dam	.....	.....	.....	0.89	12.7
Victor	54	5	32.0	0.33	5.0
Vilas	.....	.....	.....	0.24	T.
Wagon Wheel Gap	66	−14	27.0	0.50	7.0
Waterdale	65	− 3	35.6	0.46	6.0
Westcliffe	69	− 6	31.0	0.24	2.5
Whitepine	50	− 9	24.0	0.19	2.0
Wray	71	− 3	37.6	0.14	1.2
Yuma	.....	.....	.....	0.24	2.6
Connecticut.					
Bridgeport	61	21	43.2	6.05	T.
Canton	59	16	38.2	5.93	.....
Colchester	67	16	40.8	7.31	T.
Falls Village	.....	.....	.....	4.80	2.0
Hawleyville	59	18	40.1	6.19	4.0
New London	63	26	43.4	7.23	T.
North Grosvenor Dale	61	17	39.2	5.63	T.
Norwalk	60	17	40.1	5.98	T.
Southington	62	17	40.6	6.15	0.5
South Manchester	.....	.....	.....	5.47	
Storrs	62	19	40.2	6.91	T.
Voluntown	62	16	41.4	5.83	
Wallingford	59	21	41.5	6.18	T.
Waterbury	60	18	41.0	5.69	0.5
West Cornwall	55	20	38.3	4.69	5.2
West Simsbury	.....	.....	.....	5.38	T.
Delaware.					
Delaware City	.....	.....	.....	3.30	
Dover	64	26	45.8	6.60	T.
Milford	66	24	46.5	7.21	T.
Millsboro	70	23	44.6	6.64	T.
Newark	60	24	43.6	5.33	T.
Seaford	64	28	45.4	5.62	0.5
District of Columbia.					
West Washington	70	22	44.2	4.90	T.
Florida.					
Apalachicola	75	38	60.2	3.48	
Arcadia	88	43	69.7	2.14	
Archer	85	36	62.8	2.59	
Avon Park	88	46	69.3	0.97	
Bartow	91	36	68.6	1.79	
Bonifay	80	30	57.8	6.20	
Brooksville	89	41	66.6	2.66	
Carrabelle	.....	.....	.....	2.66	
Cedarkey	81	46	64.2	1.94	
Clermont	88	40	68.3	0.53	
De Funiak Springs	79	30	57.2	5.94	
Deland	86	37	65.2	.....	
Eustis	87	39	66.6	0.80	
Federal Point	87	42	64.8	1.19	
Fenholloway	84	34	60.0	3.32	
Fernandina	85[g]	44[f]	64.0[f]	2.22	
Fort Meade	88	38	67.8	1.11	
Fort Myers	86	47	69.8	0.94	
Fort Pierce	88	51	71.2	2.87	
Gainesville	86	41	62.6	2.38	
Galt	80	29	57.6	5.90	
Grasmere	83	44	66.2	.....	
Huntington	84	41	63.8	1.06	
Hypoluxo	84	55	74.2	0.35	
Inverness	84	37	62.7	1.06	
Jasper	83	34	60.0	2.29	
Kissimmee	86	42	67.5	0.40	
Lake City	85	36	61.0	2.10	
Madison	83	36	59.6	3.24	
Malabar	87	45	70.0	1.67	
Manatee	86	43	68.8	1.14	
Merritts Island	89	54	69.8	0.33	
Miami	88	53	74.0	3.08	
Molino	83	26	57.1	6.92	
Monticello	81	34	59.2	2.68	
Mount Pleasant	82	29	58.2	2.65	
New Smyrna	84	42	65.0	0.65	
Ocala	87	39	65.4	1.37	
Orange City	92	36	65.0	1.40	
Orlando	87	43	67.4	0.29	
Panasoffkee	85	38	65.0	2.32	
Rockwell	91[d]	38[d]	64.4[d]	0.60	
St. Andrew	78	31	57.8	5.93	
St. Augustine	83	44	64.2	2.18	
St. Leo	85	43	66.8	2.00	

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
***Florida*—Cont'd.**					
Switzerland	86	41[e]	62.6[b]	2.33	
Tallahassee	81	36	58.8	1.80	
Tarpon Springs	86	39	65.4	1.16	
Wausau	81	30	56.1	......	
Georgia.					
Adairsville	72	24	48.7	5.16	T.
Albany	78	28	55.2	4.66	
Allapaha	80	30	56.2	3.77	
Americus	72	28	52.3	7.11	
Athens	73	29	49.2	6.06	
Bainbridge	83	28	58.8	4.16	
Blakely	79	28	55.3	5.06	
Brunswick	83	36	61.3	1.31	
Camak	76	26	52.4	8.02	
Clayton	75	23	48.2	8.77	
Columbus	76[e]	30[e]	53.2[e]	8.05	
Covington	77[e]	29[e]	51.0[e]	6.77	
Cuthbert	77	25	54.6	6.82	
Dahlonega	70	24	47.1	7.87	
Diamond	68	24	46.8	5.82	T.
Dublin	......	......	......	4.15	
Dudley	78	28	55.2	4.75	
Eastman	80	29	55.8	3.10	
Eatonton	77	25	51.6	5.19	
Elberton	74	25	49.3	7.62	
Experiment	75	28	51.6	5.13	
Fitzgerald	78	28	56.3	1.95	
Fleming	84	28	56.4	1.83	
Fort Gaines	75	24	53.0	5.59	
Gainesville	69	27	47.5	5.65	
Gillsville	74	26	49.8	6.68	
Glenville	80	32	56.3	1.78	
Greenbush	71	21	47.2	6.66	T.
Greensboro	77	24	50.7	6.81	
Griffin	77	31	51.5	6.10	
Harrison	75	25	52.5	5.26	
Hawkinsville	75	25	52.1	3.35	
Helena	76	29	56.2	2.82	
Lisbon	79	24	50.9	6.94	
Lost Mountain	75	25	49.1	6.73	
Louisville	73	29	52.8	5.49	
Lumpkin	78	26	55.0	6.98	
Marshallville	78	25	52.8	6.16	
Mauzy	83	30	58.9	2.78	
Milledgeville	77	25	51.4	4.64	
Millen	77	26	52.8	3.15	
Montezuma	......	......	......	8.50	
Monticello	80	28	52.4	6.42	
Morgan	74	34	55.8	5.28	
Newnan	79	26	51.7	7.74	
Point Peter	77	23	49.0	7.13	
Poulan	82	27	56.4	2.65	
Putnam	80	26	56.4	6.86	
Quitman	90	33	58.2	2.35	
Ramsey	72	23	49.8	5.27	
Rome	74	22	47.7	6.33	T.
St. Marys	85	36	60.6	1.07	
Screven	83[e]	30[e]	58.0[e]	1.76	
Statesboro	79	30	55.3	1.95	
Talbotton	77	25	53.2	8.08	
Tallapoosa	76	24	50.6	7.38	
Toccoa	72	26	47.6	7.22	
Valona	84	30	57.1	1.81	
Washington	75	26	51.4	6.35	
Way Cross	83	31	58.2	2.00	
Waynesboro	76	30	55.6	4.52	
West Point	76	25	50.0	8.12	
Woodbury	76	20	50.5	6.62	
Idaho.					
Albion	63	11	36.4	......	
American Falls	63	10	36.4	1.35	
Blackfoot	61	10	35.0	0.16	2.0
Bonners Ferry	56	18	37.4	2.42	7.0
Buhl	61	21	40.0	0.49	0.5
Burke	58	12	34.0	4.54	26.3
Caldwell	64	18	39.5	0.65	
Cambridge	65	17	38.7	1.65	T.
Chesterfield	59	7	32.8	0.20	2.0
Cœur d'Alene	......	......	......	2.73	T.
Dent	61	29	41.4	2.80	
Driggs	54	11	30.1	0.05	0.5
Ellersile	66	21	40.8	0.92	2.0
Emmett	67	18	40.6	0.66	
Forney	68	−2	30.4	1.24	10.3
Garnett	66	22	43.8	0.83	
Hot Springs	67	18	42.6	0.37	2.0
Idaho Falls	60	11	34.8	0.27	1.0
Kellogg	64	21	39.8	2.18	0.5
Lake	60	10	31.3	0.70	7.0
Lakeview	56	25	39.4	3.40	T.
Landore	59	14	33.6	3.99	26.2
Lardo	60	6	32.2	1.84	14.0
Lost River	57	7	30.3	0.10	1.0
Meadows	59	12	34.0	1.65	15.0
Milner	66	14	37.6	1.04	11.5
Moscow	57	24	49.2	0.98	T.
Mountain Home	63	16	38.8	0.60	T.
Murray	59	19	35.7	3.63	T.
***Idaho*—Cont'd.**					
Murtaugh	62[e]	12[e]	36.8[d]	0.58	3.0
Nevens Ranch	......	......	......	1.82	T.
Oakley	66	19	39.6	0.62	T.
Orofino	66	21	39.7	2.61	
Paris	67	10	34.0	0.23	2.3
Payette	65	18	40.1	0.39	T.
Pollock	......	......	......	0.77	
Poplar	......	......	......	0.71	
Porthill	54	21	37.8	2.13	5.0
Roosevelt [f]	52	−3	22.1	......	......
Rupert	65	12	36.2	0.65	2.5
St. Maries	64	22	40.4	2.07	T.
Salem	......	......	......	0.19	1.9
Salmon	56	13	33.2	0.77	3.4
Standrod	......	......	......	0.56	7.3
Sugar City	56	13	33.0	0.07	1.4
Twin Falls	69	15	39.2	0.72	4.0
Vernon	57	15	34.1	0.20	2.0
West Lake	......	......	......	0.85	7.6
Weston	62	12	40.6	0.15	1.5
Illinois.					
Albion	63	18	42.0	4.02	
Aledo	56	13	38.2	1.40	0.2
Alexander	63	17	40.4	1.25	T.
Antioch	56	14	36.2	1.87	T.
Astoria	60	12	38.4	1.78	T.
Aurora	56	13	36.6	1.62	1.0
Benton	......	......	......	4.78	
Bloomington	61	18	39.7	2.17	T.
Bushnell	61	16	40.1	1.17	T.
Cambridge	57	17	38.3	1.23	0.5
Carlinville	66	16	41.7	1.78	T.
Carlyle	......	......	......	2.41	0.5
Carrollton	69	18	42.4	3.25	
Charleston	60	16	39.4	2.60	0.1
Chester	70	23	47.6	3.80	T.
Cisne	68[e]	19[e]	43.7[e]	3.61	
Coatsburg	61	15	39.8	1.49	
Cobden	70	20	45.6	5.17	T.
Colchester	60	16	39.8	1.07	T.
Decatur	62	18	39.9	2.07	T.
Dixon	53	4	39.1	1.23	2.2
Dwight	58	15	37.7	2.02	2.7
Equality	69	23	45.4	4.96	T.
Flora	66	16	41.2	2.92	T.
Friendgrove	66	19	42.2	4.47	T.
Galva	59	17	37.9	1.43	0.5
Grafton	......	......	......	1.64	T.
Greenville	70	20	42.8	1.82	T.
Griggsville	62	19	41.6	1.80	T.
Havana	63	23	41.2	1.59	T.
Henry	60	12	38.2	1.92	2.0
Hillsboro	65	20	42.2	1.77	T.
Hoopeston	59	16	38.1	2.27	2.6
Joliet	56	17	37.8	1.86	1.5
Kishwaukee	57	12	36.6	1.31	3.5
Knoxville	57	12	37.7	1.32	T.
La Grange	55	16	37.7	1.15	T.
La Harpe	60	14	38.8	0.90	T.
Lanark	56	8	35.2	1.41	1.6
Lincoln	62	19	40.8	2.01	T.
Loami	......	......	......	2.26	T.
McLeansboro	66	22	42.7	3.83	
Martinsville	65[f]	17[f]	41.1[f]	3.40	0.5
Martinton	64	16	38.7	2.70	2.0
Mascoutah	68	20	43.4	2.76	T.
Minonk	60	18	39.2	1.89	1.0
Monmouth	59	15	39.4	1.46	T.
Morrison	63	10	37.6	1.42	2.0
Morrisonville	63	17	40.4	2.08	T.
Mount Carmel	......	......	......	4.72	T.
Mount Vernon	73	20	43.8	3.64	T.
New Burnside	69	17	43.0	4.30	T.
Olney	66	19	42.8	3.57	T.
Ottawa	65	17	39.0	1.96	2.6
Palestine	65	19	41.3	2.90	T.
Pana	63	19	41.0	1.95	T.
Paris	62	19	39.4	3.47	1.0
Philo	61	13	37.0	2.27	0.8
Pontiac	57	17	39.9	2.04	1.0
Rantoul	60	17	38.6	2.17	2.2
Raum	71	20	45.4	4.78	
Riley	55	12	36.4	1.20	1.2
Robinson	66	19	42.8	3.30	
Rockford	54	15	37.5	0.98	0.3
Rushville	68	17	41.4	1.30	T.
St. John	70	20	43.9	3.66	T.
Streator	61	15	37.8	2.06	3.0
Sullivan	63	18	40.9	2.41	
Sycamore	56	13	35.8	1.42	1.0
Tilden	72	20	43.8	3.17	0.2
Tiskilwa	58	16	38.0	1.59	2.0
Tuscola	61	15	39.7	1.93	T.
Urbana	60	16	37.8	1.99	0.6
Vernon	70	20	42.9	2.50	T.
Walnut	57	16	38.1	1.41	2.7
Warsaw	64	15	39.6	1.92	0.1
Winnebago	55	11	36.1	1.45	4.0
***Illinois*—Cont'd.**					
Yorkville	56[b]	13	36.0[d]	1.25	1.0
Zion	63	11	35.3	1.99	4.0
Indiana.					
Anderson	61	18	39.3	2.18	2.0
Auburn [1]	54	14	33.7	......	......
Bloomington	......	......	......	4.20	T.
Bluffton	56	15	37.8	2.44	1.0
Butlerville	62	20	40.3	3.32	1.5
Cambridge City	60	15	37.3	2.89	......
Columbus	61	18	39.8	2.80	T.
Connersville	66	16	38.5	3.45	0.5
Delphi	60	15	37.0	2.31	T.
Elkhart	54	22	38.2	1.92	4.5
Eminence	61	18	41.0	3.02	1.0
Farmersburg [e]	68	18	42.0		
Farmland	56	18	38.6	1.97	0.5
Fort Wayne	57	16	38.6	2.39	2.5
Franklin	62	18	39.8	2.13	1.3
Greenfield	61	19	40.4	3.36	1.0
Greensburg	58	21	41.0	2.92	3.0
Hammond	65	20	38.1	1.91	8.0
Huntington	56	18	38.6	2.37	1.0
Jeffersonville	70	23	42.8	3.05	T.
Judyville	62	13	37.2	2.17	1.2
Knox	54	14	37.0	2.37	2.5
Kokomo	58	15	39.1	1.74	1.0
La Fayette	59	18	38.2	1.32	T.
Laporte	55	21	38.0	3.00	4.8
Lima	58	16	36.6	1.58	T.
Logansport	59	17	39.0	2.12	T.
Madison	65	21	41.7	3.06	T.
Marengo	69	19	42.7	3.88	T.
Marion	56	17	38.2	2.00	2.5
Markle	56	14	37.2	2.40	T.
Mauzy	59[e]	16[e]	39.0[e]	3.30	1.8
Moores Hill	63	20	40.8	2.71	0.8
Mount Vernon	67	20	44.8	4.83	T.
Northfield	59	11	37.9	2.00	0.5
Paoli	67	18	40.6	4.17	T.
Plymouth	54	16	37.3	2.19	......
Princeton	65	18	42.5	2.95	
Richmond	59	16	37.8	2.74	0.5
Rochester	55	19	38.1	2.57	2.2
Rockville	59	20	39.8	2.96	1.0
Rome	75	21	44.5	3.66	T.
Salamonia	57	14	38.4	1.64	T.
Salem	65	18	40.0	3.91	0.5
Scottsburg	64[b]	22[d]	42.8[e]	......	1.0
Shelbyville	62	18	39.4	2.67	T.
South Bend	56	26	37.9	2.36	6.5
Terre Haute	62	23	42.5	3.12	1.0
Veedersburg	65[d]	16[d]	40.1[d]	1.93	1.0
Vevay	63	18	41.6	2.90	T.
Vincennes	66	19	41.2	4.13	T.
Washington	64	20	41.0	3.70	T.
Worthington	64	18	41.3	3.27	T.
Zelma	62	19	40.8	3.86	T.
Indian Territory.					
Ada	77	28	52.0	2.32	
Bartlesville	80	17	48.6	2.04	T.
Chickasha	78	16	48.7	2.03	
Durant	78	16	50.2	3.93	
Fairland [f]	80	17	45.0	......	......
Holdenville	77	14	47.5	2.63	
Idabel	75	19	48.0	5.22	
Marlow	77	16	48.8	1.96	
Muskogee	77	14	47.2	2.32	
Okmulgee	81	11	48.9	1.83	
Ravia	80	13	50.0	2.91	
South McAlester	80	15	51.8	1.39	T.
Tulsa	78	16	47.6	1.63	
Vinita	78[d]	15[d]	47.3[d]	2.40	T.
Wagoner	79	15	48.2	2.23	
Webbers Falls	81	10	46.7	2.95	
Iowa.					
Afton	60	15	38.2	1.35	T.
Albia	58	15	38.2	1.08	0.1
Algona	56	6	34.0	1.41	1.0
Allerton	63	14	39.2	1.09	0.7
Alta	60	8	35.0	1.26	1.3
Alton	58	9	35.7	0.78	T.
Amana	57	13	36.9	1.04	1.2
Ames	59	12	36.0	1.02	1.0
Atlantic	67	8	35.8	0.88	T.
Audubon	59	11	36.0	0.88	0.9
Baxter	68	12	37.0	1.04	1.0
Bedford	66	10	43.6	1.52	T.
Belle Plaine	66	11	37.2	1.06	2.0
Bloomfield	60	15	39.9	1.07	0.3
Bonaparte	59	14	39.1	0.98	
Boone	60	13	36.6	0.99	1.0
Britt	56	5	33.0	0.90	1.7
Buckingham	......	......	......	1.18	2.0
Burlington	63	17	39.7	1.53	T.
Carroll	63	10	35.6	1.40	T.
Cedar Rapids	56	14	36.0	0.76	1.0
Chariton	60	14	38.0	0.85	1.0
Clarinda	67	9	39.0	1.88	T.

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Temperature. (Fahrenheit.) Minimum.	Temperature. (Fahrenheit.) Mean.	Precipitation. Rain and melted snow.	Precipitation. Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
Iowa—Cont'd.					
Clear Lake	56	9	35.3	0.78	1.0
Clinton	57	13	36.7	1.31	2.0
Columbus Junction	58	17	38.9	0.83	T.
Corning	59	11	37.0	1.45	0.2
Corydon	62	13	39.8	0.91	.....
Creston	61	15	37.4	1.60	0.5
Cumberland				1.42	T.
Decorah	53	12	35.8	1.40	1.0
Delaware	53	12	34.6	1.02	3.0
Denison	62	11	37.6	1.65	T.
De Soto	62	12	38.5	1.10	T.
Dows	58	6	34.6	0.85	0.8
Earlham	61	10	37.2	1.17	.....
Elliott	62	12	36.4	1.33	T.
Elma	52	−4	32.3	0.76	1.6
Estherville	59	4	34.2	0.91	0.5
Fayette	53	6	34.0	1.67	2.4
Forest City	59	7	34.5	1.05	0.5
Fort Dodge	58	12	35.2	1.30	1.5
Fort Madison				0.94	T
Gilman				0.99	1.5
Grand Meadow	52	11	34.7	1.38	3.5
Greenfield	62	14	38.4	0.88	T.
Grinnell	57	12	37.0	0.90	0.5
Grundy Center	57	11	37.1	0.77	1.0
Guthrie Center	58	12	37.2	0.99	T.
Hampton	60	10	36.1	0.92	1.5
Hancock	63	15	38.4	1.50	T.
Harlan	65	11	36.6	0.53	T.
Humbolt	60	9	35.3	0.96	1.0
Independence	64	11	36.8	0.56	0.5
Indianola	59	16	37.8	1.34	0.4
Inwood	60	5	35.5	0.09	0.3
Iowa City	58	12	36.8	1.07	0.5
Iowa Falls	56	10	34.8	0.84	1.0
Keosauqua	60	12	37.6	0.97	T.
Lacona				1.48	3.0
Larrabee	57	9	34.6	0.42	T.
Le Mars	58	9	36.7	0.52	.....
Lenox	61	12	38.0	1.32	0.2
Leon	60	16	38.4	1.37	4.2
Little Sioux	65	10	38.2	1.09	T.
Logan	63	13	37.8	2.27	1.5
Maple Valley				0.41	1.0
Marshalltown	58	12	35.7	1.06	T.
Mason City	54	8	34.2	0.68	0.8
Massena	66	11	38.0	0.94	T.
Mount Ayr	66	16	39.6	1.56	2.0
Mount Pleasant	60	16	38.6	1.23	T.
Murray	62	14	38.8	1.31	2.2
New Hampton	51	9	33.9	0.75	1.0
Newton	57	13	37.3	1.04	1.0
Northwood	54	8	34.4	0.93	2.7
Odebolt	66	9	37.1	0.97	0.2
Olin	58	12	36.4	1.26	3.0
Onawa	62	14	39.2	0.59	0.5
Osage	57	8	35.2	0.88	2.0
Oskaloosa	58	13	37.8	0.94	0.2
Ottumwa	67	17	40.1	1.30	
Pacific Junction	64	14	38.0	1.53	T.
Pella	58	16	38.9	0.92	.....
Perry	60	12	36.6	1.23	2.5
Plover	58	2	33.0	1.30	2.0
Pocahontas	58	8	33.6	1.58	1.8
Ridgeway	59	8	36.6	1.39	2.2
Rock Rapid	60	8	34.4	0.10	1.0
Rockwell	60	9	35.7	1.35	1.0
St. Charles	64	15	40.2	1.03	1.3
Sheldon	60	7	35.8	0.52	5.0
Sibley	60	4	32.9	0.85	1.0
Sigourney	57	15	38.0	0.93	0.5
Sioux Center	59	9	34.7	0.13	1.0
Stockport	58	13	39.2	1.05	T.
Storm Lake	60	10	36.1	0.78	0.8
Thurman	63	13	38.4	1.74	T.
Tipton	56	18	38.6	1.13	
Toledo	55	11	36.0	0.75	0.5
Wapello				0.83	0.2
Washington	58	15	38.4	0.80	T.
Washta	62	6	35.6	0.71	0.5
Waterloo	59	13	37.3	0.92	1.0
Waukee	66	15	37.7	1.51	3.5
Waverly	54	12	35.4	1.06	.....
Webster City	58	9	35.8	0.74	T.
West Bend	56	6	33.8	1.49	0.3
Whitten	56	9	35.7	0.83	1.0
Wilton Junction	55	13	35.6	0.95	T.
Winterset	58	16	38.0	0.83	0.5
Woodburn	66	15	39.0	0.45	3.5
Zearing	59	10	35.6	0.90	0.6
Kansas.					
Abilene				1.02	
Anthony	82	18	47.0	1.13	
Ashland	80	7	44.4	0.43	T.
Atchison	70	17	42.3	0.94	T.
Baker	69	20	42.4	1.00	T.
Burlington	75	16	44.6	1.49	T.
Chapman	75	17	42.6	0.80	
Kansas—Cont'd.					
Cimarron	75	4	40.5	0.45	1.0
Clay Center	72	13	44.2	0.75	T.
Colby	73	3	39.6	0.29	0.3
Coldwater	75	10	45.0	0.22	T.
Columbus	73	17	44.5	2.08	1.0
Coolidge	78	0	40.1	0.28	T.
Cottonwood Falls	76	16	42.8	1.02	T.
Cunningham	80	13	47.1	0.45	T
Dresden	70	3	40.4	0.30	T.
Eldorado	71	16	43.8	1.15	T.
Ellinwood	75	11	42.6	0.18	T.
Ellsworth	75	10	42.4	0.18	
Emporia	72	18	44.0	0.85	T.
Enterprise	73	15	42.6	0.69	T.
Eskridge	69	16	42.0	0.84	T.
Eureka			.....	1.50	T.
Fall River	75	17	44.8	1.40	T.
Farnsworth	76	−1	40.6	0.22	0.5
Fort Scott	77	17	44.0	1.79	T.
Frankfort	78	12	41.3	1.45	T.
Fredonia	78[e]	18[e]	45.3[e]	1.40	T.
Garden City	78	4	39.8	0.16	0.1
Garnett	74	15	44.8	1.61	T.
Goodland	72	4	39.9	0.50	2.0
Gove *1	74	8	40.8	0.34	
Greensburg	75	9	43.2	T.	T.
Grenola	75	14	44.7	1.60	T.
Hanover	73	13	41.8	1.58	T.
Harrison	66	9	39.4	0.17	T.
Hays	73	2	40.0	0.11	T.
Horton	67	16	42.0	1.55	T.
Howard			.....	1.45	T.
Hoxie	70	2	39.4	0.40	
Hutchinson	74	15	43.8	0.56	
Independence	75	19	46.2	2.04	T.
Jetmore	79	6	42.4	0.15	0.5
Jewell	68	10	41.6	0.13	
La Crosse	76[e]	6[e]	43.2[e]	0.32	
Lakin	73	3	39.8	0.15	
Larned	77	7	41.4	0.18	
Lebanon	68	14	41.8	0.18	T.
Lebo	73	18	42.8	1.29	T.
Liberal	82	6	44.8	0.29	...
Macksville	74	9	43.0	T.	T.
McPherson	71	15	42.9	0.62	
Madison	76	15	46.6	1.43	T.
Manhattan	77	16	42.2	1.14	
Manhattan Agr. College	75	15	41.4	1.12	T.
Marion	67	17	41.3	0.95	
Minneapolis	71	13	40.6	0.36	T.
Moran	73	17	45.1	1.71	T.
Mount Hope	.....	.....	.....	0.63	
Newton	.....	.....	.....	1.13	
Norton	76	−4	37.4	0.20	T.
Norwich	77	16	45.5	0.81	T.
Oberlin	.....	.....	.....	0.30	1.0
Olathe	71	16	42.6	1.45	T.
Osage City	73	15	41.7	0.93	
Oswego	77	19	45.9	2.28	T.
Ottawa	75	16	42.2	1.54	T.
Paola	74	16	42.0	1.48	T.
Phillipsburg	69[j]	5[j]	37.8[j]	0.18	T.
Plainville	72[j]	6[j]	42.8[j]	0.15	
Pleasanton	72	18	43.3	1.47	
Pratt	76	11	44.2	0.46	
Republic	65[h]	9[h]	37.8[h]	0.10	T.
Rome	75	18	44.8	1.11	
Russell	74	10	41.8	0.13	
Salina	73	12	43.0	0.28	T.
Scott	79	4	41.4	0.16	0.2
Sedan	73	18	44.9	1.85	
Toronto	81	17	46.2	1.80	
Ulysses	74[e]	5[e]	40.4[e]	0.20	T.
Valley Falls	70	16	42.2	1.46	T.
Wakeeney	74	4	41.4	0.17	
Wakeeney (near)	.....	.....	.....	0.25	T.
Wallace	75	0	39.3	0.21	T.
Walnut	75	17	45.5	1.87	
Winfield	70	18	44.0	1.25	
Kentucky.					
Alpha	69	22	45.4	4.80	T.
Anchorage	70	19	41.5	3.26	0.5
Bardstown	72	21	43.6	2.98	
Beattyville	73	17	42.3	3.80	1.0
Beaver Dam	71	18	41.8	3.42	
Berea	72	18	44.4	5.37	T.
Blandville	71	24	47.2	5.47	.....
Bowling Green	71	22	46.0	3.77	T.
Burnside	69	19	45.4	3.82	T.
Cadiz	72	19	46.2	3.62	T.
Calhoun	71*	22	45.1	4.18	T.
Catlettsburg	74	21	46.8	2.38	T.
Earlington	75	20	43.5	4.19	
Edmonton	68	18	44.3	4.20	0.1
Eubank	70	19	41.9	4.32	T.
Falmouth	.....	.....	.....	2.70	
Farmers	71[k]	15[k]	43.8[k]	.....	
Frankfort	68	19	42.6	1.21	
Kentucky—Cont'd.					
Franklin	75	22	46.3	3.18	T.
Greensburg	73	16	42.2	3.79	T.
Hopkinsville	74	19	45.4	4.25	
Irvington	67	24	43.4	3.99	T.
Leitchfield	70	19	43.7	4.02	T.
Loretto	69	18	44.4	1.75	
Lynnville	73	20	46.3	4.00	T.
Maysville	70	17	41.6	2.48	
Mount Sterling	69	22	42.6	3.57	
Owensboro	76	23	45.6	4.45	
Owenton	70[c]	25[d]	41.8[c]	.....	
Paducah	71	26	47.3	4.76	
Richmond	72	23	44.4	3.08	
St. John	71	20	41.2	4.19	
Scott	65	21	41.9	2.32	0.1
Shelby City	71	16	42.5	4.05	T.
Shelbyville	69	18	40.6	3.15	
Taylorsville	69	18	42.0	3.81	T.
West Liberty	73	18	44.6	2.85	
Williamsburg	75	19	43.5	5.00	2.5
Williamstown	67	21	41.4	2.23	
Louisiana.					
Abbeville	83	27	56.8	5.42	
Amite	81	26	54.9	5.25	
Baton Rouge	81	26	54.2	3.98	
Burnside	83[e]	28[e]	56.6[e]	5.00	
Cameron	80	32	58.6	6.01	
Cheneyville	84	23	50.4	3.49	
Clinton	80	27	55.4	6.62	
Collinston	78	23	51.4	4.54	T.
Covington	84	30	55.6	5.91	
Donaldsonville	82	30	57.6	4.96	
Farmerville	.....	.....	.....	6.12	T.
Ferriday	83	21	54.3	6.56	
Franklin	86	32	58.4	6.79	
Grand Cane	82	19	52.2	8.83	T.
Grand Coteau	84	27	57.6	7.70	
Houma	80	31	56.8	4.10	
Jennings	82	26	56.6	4.87	
La Fayette	83	27	55.0	6.01	
Lake Charles	84	29	55.7	4.70	
Lakeside	85	29	57.6	7.24	
Lawrence	82	35	59.2	5.48	
Libertyhill	.....	.....	.....	6.86	T.
Melville	82	26	56.4	6.45	
Minden	82	17	50.7	7.78	T.
Monroe	82	20	52.9	5.12	T.
Newellton	87	19	53.3	5.95	
New Iberia	81	28	58.1	4.52	
Opelousas	87	25	56.6	5.78	
Plain Dealing	81	17	51.8	8.62	T.
Rayne	83	28	57.3	7.30	
Reserve	90	28	57.5	4.85	
Robeline	.....	.....	.....	3.25	T.
Ruston	85	22	55.3	5.80	T.
Schriever	91	29	58.8	3.59	
Southern University	.....	.....	.....	5.23	
Sugar Experiment Station	79	35	58.4	5.15	
Sugartown	80	27	54.3	4.43	
Tallulah	82	18	52.8	4.82	
Maine.					
Bar Harbor	56	17	38.4	5.30	1.0
Cornish	57	12	34.2	6.04	6.0
Danforth	.....	.....	.....	3.48	0.1
Fairfield	55	17	34.7	3.66	3.0
Farmington	57	10	33.8	4.50	3.0
Gardiner	59	18	36.6	4.97	4.0
Houlton	59	10	34.2	2.10	T.
Lewiston	60	16	35.5	4.25	2.6
Madison	56	11	33.7	6.28	1.0
Mayfield	57	15	32.2	5.35	4.0
Millinocket	69	11	34.2	3.75	2.0
Oquossoc	.....	.....	.....	4.80	9.0
Orono	57	10	35.6	4.22	1.0
Patten	55	16	34.6	5.30	3.0
Rumford Falls	56	16	34.3	5.14	2.5
The Forks	.....	.....	.....	4.76	5.0
Van Buren	53	0	30.0	3.00	2.0
Winslow	58	16	35.6	4.49	2.0
Maryland.					
Annapolis	60	32	45.5	6.19	T.
Bachmans Valley	59	23	42.6	7.31	1.0
Cambridge	65	26	46.5	6.65	T.
Chestertown	63	29	45.1	7.81	T.
Chewsville	62	19	40.8	3.79	1.5
Clear Spring	61	24	39.9	4.15	T.
Coleman	64	27	46.1	8.45	
College Park (Md. Ex. Sta.)	70	19	42.8	4.64	T.
Cumberland	.....	.....	.....	3.69	T.
Darlington	61	26	44.9	6.44	T.
Denton	65	22	45.4	8.28	T.
Easton	64	27	46.4	7.35	
Emmetsburg	60	25	42.8	5.31	0.5
Fallston	60	24	43.1	6.93	1.0
Frederick	63	22	43.0	4.51	1.0
Frostburg	.....	.....	.....	4.73	9.5
Grantsville	61	16	36.7	4.60	10.0
Great Falls	65	20	42.9	4.25	.....

TABLE II.—*Climatological record of coöperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
	°	°	°	Ins.	Ins.
***Maryland*—Cont'd.**					
Greenspring Furnace	60	18	41.3	4.14	T.
Harney				4.46	T.
Jewell	65	27	45.4	6.60	T.
Keedysville	64	21	42.8	4.26	T.
Lake Montebello				5.59	
Laurel	66	21	43.3	5.61	T.
Monrovia	63	25	43.0	4.90	1.0
Oakland	69	11	37.1	4.32	4.2
Pocomoke City	65	26	47.2	5.07	T.
Portobello	65	29	47.1	4.57	T.
Princess Anne	65	23	45.8	5.22	0.5
Salisbury	68	22	46.3	5.63	T.
Sudlersville	64	28	45.0	6.32	
Takoma Park	66	25	43.6	4.57	T.
Taneytown	60	20	41.8	4.73	T
Towson				4.80	0.8
Van Bibber				6.67	T.
Western Port	62	19	40.7	3.52	1.5
Woodstock	61	24	45.0	4.59	T.
Massachusetts.					
Amherst	60	20	38.6	4.50	1.0
Bedford	60	20	39.6	5.24	T.
Bluehill (summit)	59	20	39.6	6.46	T.
Chestnut Hill	61	21	41.6	7.91	T.
Concord	60	19	38.8	5.42	T.
Fall River	60	26	43.4	6.61	T.
Fitchburg	59	21	38.8	4.96	3.5
Framingham	61	15	39.0	5.84	T.
Groton	60	17	36.8	5.80	6.0
Hyannis	57	25	43.0	5.88	2.0
Jefferson				6.02	4.0
Lawrence	60	19	39.2	5.46	0.5
Leominster				5.32	2.2
Lowell	59	20	39.8	5.77	T.
Middleboro	62	17	41.0	5.02	
Monson	60	18	39.2	5.72	5.2
New Bedford	60	28	45.0		
Plymouth	60	24	42.2	4.64	T.
Princeton				5.52	2.5
Provincetown	56	26	42.4	5.11	T.
Salem				5.99	
Sterling				5.43	2.5
Taunton	60	16	40.0	6.87	T.
Westboro	60	20	40.8	6.41	T.
Weston				6.09	
Williamstown	58	20	37.1	3.42	1.7
Worcester	58	22	40.4	4.57	3.1
Michigan.					
Adrian	57	16	37.0	1.86	0.5
Agricultural College	54	17	36.0	1.83	0.3
Allegan	52	18	36.6	2.60	3.0
Alma	57	13	36.0	2.98	T.
Ann Arbor				2.34	5.5
Arbela	55	16	36.7	2.45	0.5
Ball Mountain	53	16	35.3	2.91	1.5
Baraga				3.32	10.2
Battle Creek	54	17	36.6	1.07	0.5
Bay City	55	15	36.5	1.40	T.
Berlin	53	15	35.2	1.98	2.0
Big Rapids	51	11	34.6	2.50	T.
Blaney				1.72	4.4
Bloomingdale	58	20	39.2	3.60	12.0
Calumet	51	15	30.3	2.93	18.5
Cassopolis	48	20	34.5	3.58	7.0
Charlevoix	58	22	37.8	2.10	4.0
Charlotte	61	15	36.0		
Chatham	49	4	30.4	3.25	22.2
Cheboygan	55	15	35.8	2.41	6.0
Clinton	57	14	35.8	1.56	0.5
Coldwater	65	15	38.6	1.94	0.3
Concord	59	15	35.8	1.53	T.
Deer Park	48	15	33.2	3.30	27.0
Detour	48	15	33.8	2.89	8.0
Durand	54	17	36.8	1.65	2.5
Eagle Harbor	56	15	34.8	2.42	10.0
East Tawas	53	10	34.2	3.44	
Eloise	55	17	38.0	1.34	3.0
Ewen	51	2	29.4	2.38	16.4
Flint	54	15	35.8	1.51	1.0
Frankfort	55	25	38.2	1.90	8.0
Grand Marais	48	18	34.6	2.75	1.1
Grape	58	18	38.1	1.36	0.8
Grass Lake	54	9	35.4	2.11	9.0
Harbor Beach	58	14	36.6	1.52	2.0
Harrison	51	10	32.8	3.25	T.
Harrisville	58	13	34.8	3.83	3.0
Hart	60	19	37.2		
Hayes	55	15	36.6	1.82	
Highland				2.27	9.0
Hillsdale	54	16	35.9	1.87	1.5
Holland	56	20	38.8	3.03	3.0
Howell	63[c]	14[c]	35.4[c]	1.50	1.1
Humboldt	47	−3	25.5	1.45	14.5
Iron Mountain	50	10	31.6	1.50	1.0
Iron River	50	2	28.4	1.30	3.0
Ishpeming				2.30	20.5
Isle Royal	45	16	32.6	2.21	11.5
Ivan	50	6	32.4	2.38	5.0
***Michigan*—Cont'd.**					
Jackson	55	18	37.2	2.26	1.5
Jeddo	56	17	36.4	1.60	0.7
Kalamazoo	53	20	37.0	1.86	0.5
Lake City	50	0	31.8	1.66	
Lansing	54	18	37.2	1.89	1.7
Lapeer	66	16	36.6	1.74	T.
Ludington	52[d]	19[d]	37.6[d]	2.64	3.0
Mackinac Island	50	18	34.7	3.55	12.0
Mackinaw	50	21	34.4		4.0
Mancelona	52	15	33.5	1.60	6.0
Maple Ridge	49	4	30.4	1.75	5.0
Menominee	50	11	34.4	1.40	T.
Midland	55	11	36.2		
Montague	51	17	36.4	2.10	2.5
Morenci	57	16	37.6	1.53	
Mount Clemens				2.10	4.7
Mount Pleasant	58	14	35.2	1.51	
Muskegon	56	18	37.0	1.95	2.0
Newberry	54	4	28.3	0.80	8.0
Old Mission	52	21	36.2	2.59	4.0
Olivet	52	18	36.1	1.99	2.2
Owosso	51	15	36.4	2.43	0.2
Petoskey	55	22	36.0	2.40	6.0
Plymouth	55	15	37.0	0.35	0.5
Port Austin	54	17	38.1	2.20	T.
Powers	50	6	31.6		
Reed City				1.90	2.0
Saginaw (W. S.)	57	15	37.4	2.02	T.
St. Ignace	59	19	35.4	2.03	5.8
St. Joseph	55	25	39.9	1.96	6.0
Saranac	56	19	36.4	2.34	T.
South Haven	50	20	36.2	5.84	14.0
Stanton *	63	19	35.0		
Thomaston	50	2	29.4	2.23	15.0
Thornville	54	14	36.6	2.84	8.0
Traverse City	55	20	35.4	2.31	6.0
Vassar				1.25	0.2
Wasepi	57	15	36.7	1.80	3.0
Webberville	54	15	34.4	2.14	2.2
Wetmore	50	2	30.2	2.04	16.2
Whitefish Point	48	18	33.4	3.36	22.2
Woodlawn	51	2	30.4	2.65	11.5
Ypsilanti	55	15	37.0	2.43	7.5
Minnesota.					
Albert Lea	55	8	33.8	0.85	T.
Alexandria	55	4	30.4	0.28	0.5
Angus	53	−2	28.0	T.	T.
Bagley	49	−4	28.2	0.59	1.0
Beardsley	56	−2	30.8	0.05	0.5
Beaulieu	53	2	29.2	T.	T.
Bird Island	55	5	33.2	0.32	T.
Blackduck	50	−8	27.9	0.29	1.9
Caledonia	50	8	34.0	1.40	3.5
Cass Lake				0.19	
Collegeville	52	9	33.0	0.17	0.1
Crookston	51	2	28.0	0.08	0.2
Detroit	55	−3	26.4	0.13	3.0
Fairmount	54	10	34.3	0.70	0.1
Faribault	56	7	34.0	0.54	T.
Farmington	56	7	33.7	1.22	1.2
Fergus Falls	54	4	31.6	0.16	0.7
Floodwood	50	1	29.0	0.34	
Fort Ripley				0.57	
Glencoe	56	5	33.2	1.21	T.
Grand Meadow	56	6	34.1	0.79	4.5
Hallock	52	−8	26.6	0.15	1.5
Halstad	54	−2	28.8	0.13	1.2
Hinckley	54	10	31.2	0.71	
Lake Crystal	55	7	34.2	0.42	0.2
Leech Lake	49	1	28.6	1.23	6.5
Litchfield	55	5	32.9	0.61	
Little Falls	52	4	32.6		
Long Prairie	54	1	31.0	0.73	T.
Lynd	58	3	32.6	0.08	1.0
McIntosh	51	−1	29.0	0.10	T.
Milan	58	1	31.8	0.07	0.7
Minneapolis *[1]	55	8	32.8	1.03	0.6
Montevideo	57	6	34.4	0.49	1.0
Mora	54	2	31.0	0.53	1.0
Morris	57	5	31.6	0.02	T.
Mount Iron	49	1	27.6	0.38	3.8
New London	58	3	31.8	0.87	T.
New Richland	52	7	33.6	0.87	0.5
New Ulm	62	9	33.6	0.46	T.
Osakis *	51	1	30.0		
Park Rapids	51	1	29.0	0.35	1.4
Pine River	52	4	29.6	0.25	3.0
Pipestone *	58	2	34.2		
Pokegama Falls	52	1	29.0	0.65	4.2
Redwing				1.00	1.0
Redwood Falls	58	7	35.4	1.21	0.5
St. Charles	62	6	34.6	0.77	
St. Cloud	55	7	33.9	0.57	T.
St. Peter				0.97	
Sandy Lake Dam	50	4	30.9	0.83	3.8
Shakopee	57	8	34.4	0.95	T.
Stephens Mines	49	−3	27.2	0.35	
Taylors Falls				1.02	
***Minnesota*—Cont'd.**					
Tonka Bay				0.52	
Two Harbors	51	7	32.2	0.50	
Wabasha	58	9	36.1	1.24	2.0
Willow River	51	2	30.6	0.30	1.3
Windom	60	2	35.6	0.67	T.
Winnebago	58	6	35.0	0.83	T.
Winnebigoshish	50	6	30.2	0.84	3.4
Winona	54	13	36.2	1.37	0.8
Worthington	60	3	32.1	0.21	T.
Mississippi.					
Aberdeen	85	21	51.1	5.33	
Agricultural College	79[d]	23[d]	49.5[d]	4.63	
Anguilla	78	20	50.8	4.40	T.
Austin	78	20	49.7	5.26	
Batesville	82	20	50.8	3.37	
Bay St. Louis	77	32	57.4	6.62	
Bellefontaine				5.54	
Biloxi	81	33	59.0	4.32	
Booneville	74[c]	24[c]	48.6[c]	4.56	
Brookhaven	83	21	53.6	6.90	
Canton	82	18	51.8	4.50	
Clarksdale	76[c]	20	50.2[b]	3.13	
Columbus	81	21	50.2	4.87	
Corinth	73	22	46.8	5.13	
Crystal Springs	80	24	52.8	8.24	
Duck Hill	80	18	50.0	5.45	T.
Edwards	82	22	54.0	7.14	
Fayette	79	16	51.2	6.45	
Fayette (near)				6.60	
Greenville	79	24	50.2	4.46	
Greenwood	81	21	50.0	4.40	
Hattiesburg	80	26	53.3	8.24	
Hazlehurst	81	24	52.8	7.26	
Hernando	77	20	50.6	4.18	
Holly Springs	74	24	47.8	3.50	
Jackson	81	21	52.0	5.93	
Kosciusko	81	20	51.1	5.04	
Lake	80	18	50.0	5.94	T.
Lake Como	81	23	53.0	6.77	T.
Laurel	81	23	53.4	5.61	
Leakesville	83	26	55.8	9.29	
Louisville	81	20	51.2	4.12	
McNeill	81	28	56.6	6.61	
Macon	80	21	49.8	3.78	
Magnolia	83	26	55.6	5.88	
Monticello	81	21	53.6	5.56	
Natchez	81	26	53.4	8.32	T.
Okolona	78	22	49.0	5.46	
Pearlington	80	29	56.1	6.66	
Pecan	79	31	56.8	7.30	
Pittsboro	77	20	49.4	4.46	
Pontotoc	74	23	49.8	4.24	
Porterville				5.13	
Port Gibson	83	20	51.8	6.36	T.
Quitman *	81	19	52.4		
Ripley	77	20	48.8	6.14	
Rosedale	80	20	51.8	3.31	
Shoccoe	79	19	51.8	3.68	
Suffolk	81	23	53.7	7.27	
Swan Lake				5.00	
Tchula				5.06	T.
Tupelo	77	21	48.8	4.01	
University	77	22	50.2	4.93	
Utica	82	22	53.6	6.87	
Water Valley	79	20	49.6	4.64	
Waynesboro	74	22	51.8	9.40	
Woodville	78	24	53.7	5.18	
Yazoo City	80	22	51.2	4.51	
Missouri.					
Appleton City	76	15	44.0	1.70	T.
Arthur	78	15	46.2	1.43	
Avalon	68	15	42.3	1.47	T.
Belle	68[f]	18[f]	44.3[f]	1.95	
Bethany	62	15	39.3	1.05	1.0
Birch Tree	70	16	44.9	3.59	
Bolivar	76	16	44.6	2.20	
Booneville				1.46	
Brunswick	66	18	41.4	1.44	T.
Caruthersville	79	20	48.2	6.03	T.
Clinton	77	19	42.5	1.60	T.
Conception	64	12	40.0	0.83	T.
Darksville	70	12	42.2	1.50	
Dean				2.82	
De Soto	69	20	44.2	3.39	T.
Doniphan	73	18	44.8	2.72	T.
Eldorado Springs	88	19	45.4	1.92	T.
Fairport				1.10	T.
Farmington	72	19	42.6	3.30	T.
Fayette	64	15	39.8	1.29	T.
Fulton	65	18	42.9	1.32	T.
Gallatin				1.20	0.1
Gano	71	18	44.8	2.17	T.
Goodland	72	13	43.7	2.82	
Gorin				1.21	T.
Grant City	63	15	40.5	1.30	T.
Harrisonville	72	18	41.0	1.43	0.2
Hazlehurst				0.86	0.5
Hermann				2.12	

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	Ins.	Ins.
Missouri—Cont'd.					
Houston	72	5	44.4	2.67	
Huntsville				1.30	
Ironton	73	15	42.6	3.85	T.
Jackson	78	19	46.6	4.02	T.
Jefferson City	67	18	41.0	1.23	T.
Joplin	73	19	46.2	2.55	T.
Kidder	66	25	44.0	1.51	0.2
Koshkonong	76	20	46.6	3.72	T.
Lamar	77	22	45.2	1.84	T.
Lamonte				1.61	T.
Lebanon	78	18	44.0	1.26	
Lexington	70	19	43.0	1.36	T.
Liberty	67	16	42.4	1.40	T.
Lockwood	76	18	45.2	2.90	T.
Louisiana	66	12	41.2	1.52	T.
Marble Hill	74	18	43.6	4.40	
Marshall	67	18	43.2	1.32	T.
Maryville	64	15	39.3	1.63	T.
Mexico	67	17	41.0	1.48	T.
Mountain Grove	70	16	44.9	2.54	T.
Mount Vernon	82	15	45.6	3.75	T.
Neosho	74	14	45.2	2.91	T.
Nevada				1.81	T.
New Madrid				5.80	
New Palestine	67	20	44.0	1.29	T.
Oakfield	68	20	44.6	1.96	T.
Olden	73	11	45.7	3.23	T.
Oregon	63	13	39.8	1.40	T.
Perryville	72	22	44.8	3.63	T.
Princeton	62	14	38.9	1.27	0.1
Rolla	70	18	43.0	2.12	T.
St. Charles	67	18	43.6	1.73	
St. Joseph				1.40	
Sikeston	73	19	45.8	5.17	T.
Steffenville	70	15	42.4	1.66	
Sublett	62	13	39.8	0.55	T.
Trenton	61	16	40.2	1.18	T.
Unionville	60	13	39.5	1.25	T.
Versailles[c]	75	16	44.3		
Warrensburg	75	19	44.5	1.43	T.
Warrenton	64	18	41.8	2.05	T.
Warsaw	80	15	44.4	1.69	T.
Wheatland				1.52	
Willow Springs[a]	72	13	44.2	3.03	
Montana.					
Adel	56	13	37.0	T.	
Anaconda	63	14	36.2	0.11	
Augusta[a]	69	5	31.0		
Babb[a]	54	10	36.6		
Billings	72	5	40.2	0.10	T.
Bowen	57[g]	0	29.6[d]	0.58	5.5
Broadview	68	— 4	36.0	0.04	0.4
Busby	69	— 7	34.0	0.28	2.4
Butte	59	18	36.6	0.10	1.0
Canyon Ferry	57	16	36.4	0.22	
Cascade	62	7	42.0	0.03	
Chester	63	1	31.5	0.02	0.2
Chinook	68	4	36.1	T.	T.
Columbia Falls	58	10	35.2	0.37	1.2
Copper				0.12	2.0
Crow Agency	70	— 1	37.0	0.35	
Dayton	62	16	35.6	0.27	0.5
Decker	70	— 4	35.0	0.20	2.0
Dillon	66	16	37.2	0.29	2.6
Ekalaka	67	1	34.8	T.	T.
Ericson				T.	T.
Fallon	59	— 1	34.6	T.	T.
Fort Benton	62	10	37.2	T.	
Fort Shaw	62	13	38.6	T.	T.
Fortine	57	12	33.1	0.67	2.5
Glasgow	68	0	32.6	T.	T.
Glendive	61	2	31.9	0.06	
Gold Butte	60	9	32.3	0.00	
Graham	69	— 1	35.0	0.14	1.4
Grayling	49[d]	0[d]	24.4[d]	0.13	2.0
Great Falls	61	15	39.6	T.	T.
Hamilton	68	17	39.6	0.40	T.
Highwood				0.06	T.
Home Park				0.70	7.0
Huntley	70	2	39.2	0.05	T.
Jordan	70	— 7	35.6	0.00	
Lewistown	68	5	36.0		
Livingston	62	14	39.9	0.34	1.0
Lodge Grass	69	1	35.9	0.40	1.5
Lubec	62	10	37.4	1.40	14.0
Missoula	60	18[g]	37.7[d]	0.22	T.
Moore				0.12	2.3
Norris	63	22	39.3	0.60	
Nye				0.71	10.0
Ovando	60	10	34.4	0.56	
Philipsburg	60	10	35.0	0.10	1.0
Plains	66	20	38.2	0.15	T.
Pleasant Valley	59	6	32.4	1.14	5.0
Poplar	70	— 2	34.9	T.	T.
Raymond	60	10	38.0	0.07	0.6
Red Lodge	62	7	33.2	0.73	8.0
Renovo	60	19	38.2	0.12	1.2
Ridge Lawn	68	0	32.4	T.	T.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	Ins.	Ins.
Montana—Cont'd.					
Saltese				3.45	12.0
Snowshoe	50	13	32.5	9.03	52.0
Springbrook	69	1	33.8	0.02	T.
Steel[c]	70	8	41.2		
Tokna	68	0	33.4	T.	
Tosten	63	17	35.4	T.	T.
Troy	60	23	36.8	2.31	13.4
Upper Lake				1.61	
Utica	61	9	37.4	T.	T.
Valentine	69	— 5	35.7	T.	T.
Wolf Creek	70	20	46.2	0.00	
Nebraska.					
Ainsworth	70	4	36.9	0.05	0.5
Albion				T.	T.
Alma	68	1	38.4	0.26	T.
Anoka	70[e]	— 1[e]	35.4[e]	0.05	0.5
Arapahoe				0.16	
Arcadia				T.	T.
Ashland	67	16	40.5	0.79	T.
Ashton				0.06	
Atkinson	68	11	35.4		
Auburn	65	13	40.6	0.82	T.
Aurora	69	10	38.5		
Beatrice	65	12	39.8	1.34	T.
Beaver	68	2	39.4	0.21	1.0
Bellevue	69	18	40.4	1.81	T.
Benkleman				T.	T.
Blair	64	14	39.4	1.07	T.
Bloomfield	69	6	36.2	0.09	0.5
Blue Hill				0.20	
Bridgeport	71	— 6	33.6	0.60	6.0
Broken Bow	73	0	37.0	0.06	T.
Burchard				0.81	T.
Burwell				0.00	
Callaway	77	0	40.3	T.	T.
Cambridge	70	— 2	38.5	0.27	1.5
Central City				0.00	
Chester				0.00	
Columbus	69	14	38.6	0.52	
Crete	64	12	40.0	0.26	
Culbertson				0.23	1.5
Curtis	66	4	34.7	T.	T.
David City	66	14	39.4	0.17	T.
Dawson	67	15	41.4	1.76	T.
Du Bois				1.28	T.
Duff				T	T.
Dunning				0.00	
Edgar				0.33	0.3
Ellis				0.95	
Ericson				T.	T.
Ewing	66	1	34.1	T.	T.
Fairbury	73	12	41.5	0.64	T.
Fairmont	71	8	37.0	0.20	
Fort Robinson	72	— 4	32.6	0.11	0.2
Franklin	68	7	39.0	0.18	T.
Fremont	67	13	39.3	0.60	T.
Fullerton	70	9	37.7	T.	T.
Geneva	72	9	39.4	0.15	T.
Genoa (near)	67	11	36.7	0.05	T.
Gering				0.45	4.5
Gosper				0.24	T.
Gothenburg	76	— 3	37.4	0.20	2.0
Grand Island	70	9	39.0	0.05	T.
Grant	69	— 6	35.5	0.30	3.0
Greeley	68	5	38.4	0.02	0.2
Guide Rock				0.33	
Haigler				0.25	T.
Halsey	74	— 2	38.0	0.08	0.8
Hartington	70	9	37.3	T.	T.
Harvard	69	8	36.4	0.18	
Hastings	68	12	38.7	0.10	
Hayes Center	70	— 2	38.2	0.22	2.2
Hay Springs	73	— 9	33.4	0.10	1.0
Hebron	70	11	40.0	0.10	T.
Hendley				0.22	
Holdrege	72	8	40.4	0.05	0.5
Hooper*[1]	65	18	37.4	0.33	T.
Imperial	71	— 5	37.6	0.25	3.5
Kearney	67	4	38.4	0.13	
Kimball	73	— 1	34.8	0.50	5.0
Kirkwood	70	5	37.2	T.	T.
Leavitt	70	10	37.4	0.73	T.
Lexington	69	8	37.4	0.05	T.
Lodgepole	72	— 8	33.2	0.50	5.0
Loup	67	5	36.0	T.	
Lynch	72	0	36.0	0.10	1.0
McCook				0.00	
McCool				0.20	
Madison	65[e]	11[e]	38.0[e]	T.	T.
Marquette				0.09	T.
Mason City				0.02	0.2
Minden	71	8	38.4	0.18	0.1
Monroe				0.03	T.
Nebraska City	66	13	39.8	0.85	T.
Nemaha				1.85	T.
Norfolk	72	9	37.0	0.02	0.2
North Loup	72	8	37.6	T.	T.
Oakdale	65	6	35.1	0.02	0.1

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	Ins.	Ins.
Nebraska—Cont'd.					
Oakland	77	11	39.3	0.90	
Odell				2.05	
Ord				0.00	
Osceola	65[e]	14[e]	38.1[e]	T.	
Palmer*[1]	66	12	39.6	0.62	T.
Pawnee City	66	11	40.6	0.92	T.
Plymouth	70	11	40.8	0.63	
Purdum	70	1	36.6	0.10	1.0
Ravenna	70	6	37.7	0.04	0.2
Redcloud	69	5	39.0	0.17	T.
Republican				0.05	
St. Libory				0.10	
St. Paul	70	7	39.2	T.	T.
Schuyler				0.20	1.0
Scottsbluff	72	—11	32.1	0.35	3.5
Seward	65	12	39.3	0.10	1.0
Springview	65	0	35.6	T.	T.
Stanton	70	8	36.5	T.	T.
Strang				T.	
Stratton				0.10	1.0
Superior	64	10	37.0	0.10	
Syracuse				2.12	
Table Rock				1.96	T
Tecumseh	66	13	40.0	0.83	T.
Tekamah	64	13	38.4	0.90	T.
Turlington	64	13	39.9	0.79	T.
University Farm	67	13	39.8	1.08	
Wahoo				0.25	T.
Wakefield	68	7	37.4	0.08	0.3
Watertown				0.09	0.9
Wauneta				0.20	2.0
Weeping Water	65	12	38.2	1.42	T.
Westpoint	68	10	39.1	0.30	
Wilber				0.00	
Wilsonville				0.10	1.0
Winnebago[j]	58	4	33.0		
Wisner				0.39	0.5
Wymore				1.52	
York	69	9	40.0	0.15	T.
Nevada.					
Amos	70	12	37.4	0.44	
Austin	65	14	38.2	1.00	10.0
Battle Mountain	57	26	39.0	0.00	
Beowawe*[5]	61	20	44.4	0.20	2.0
Carlin*[1]	68	10	32.7	T.	T.
Carson Dam	69	20	41.2	0.26	0.0
Clover Valley	64	10	37.0	0.27	1.2
Columbia	62	14	40.4	0.00	
Eureka	64	8	38.4	0.70	10.0
Fallon	76	18	39.8	0.21	
Fenelon				1.00	10.0
Fernley	68	20	42.4	T.	T.
Geyser				0.10	1.0
Golconda	69	17	40.2	0.20	2.0
Halleck *[5]	65	10	38.2	0.21	2.1
Humboldt*[1]	74	30	49.0	0.05	0.5
Jean	74	38	57.9	0.00	
Las Vegas	78	22	52.6	0.00	
Leetville	67	18	40.4	0.34	
Lewers Ranch	65	18	42.5	T.	T.
Logan	78	28	53.9	0.00	
McAfees Ranch	64	— 1	33.4	0.00	
Mill City*[1]	64	18	38.7	0.60	6.0
Millett	65	4	36.0	0.00	
Mina	58	21	37.8	0.00	
Palmetto	60	8	37.4	T.	T.
Paradise				0.11	1.0
Potts	57	6	32.5	0.20	3.5
San Jacinto	63	10	35.0	0.50	5.7
Soda Lake	67	20	42.0	0.35	
Squaw Valley	68	2	34.2	0.00	
Tecoma	70	14	38.8	T.	T.
Verdi*[1]	68	20	40.4		
Wabuska	70	10	38.4	0.02	0.2
New Hampshire.					
Alstead	55	15	34.6	4.64	6.0
Bethlehem	56	6	32.0	2.49	8.0
Brookline	60	18	38.7	5.08	3.2
Durham	58	18	37.5	4.38	2.5
Franklin Falls	60	12	35.2	4.44	4.0
Grafton	55	1	32.6	3.59	4.0
Hanover	60	7	34.2	3.15	4.6
Keene	60	15	36.4	3.44	4.1
Nashua	58	16	37.3	5.06	3.5
Newton	60	17	37.2	5.72	1.0
Plymouth	55	3	33.2	4.26	2.2
New Jersey.					
Asbury Park	61	29	44.7	5.65	T.
Bayonne	61	25	43.6	4.97	T.
Belvidere	64	20	42.0	6.83	2.3
Bergen Point	64	25	43.8	6.60	0.2
Beverly	63	21	43.6	5.12	T.
Bridgeton	65	24	45.4	5.97	T.
Brown Mills	68[d]	18[f]	42.8[e]	5.36	T.
Burlington				5.47	0.2
Canton				6.23	T.
Cape May C. H				6.16	1.5
Charlotteburg	58	14	40.0	6.52	1.

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
New Jersey—Cont'd.					
Clayton	65	22	44.2	5.85	T.
College Farm	64	20	42.1	5.48	1.2
Culvers Lake				5.70	3.0
Dover	55	18	39.0	6.93	1.5
Egg Harbor City				6.95	0.2
Elizabeth	60	25	43.9	4.99	1.0
Englewood	62	30	45.0	5.69	3.0
Flemington	60	22	43.0	5.95	1.5
Friesburg	64	23	44.2	5.76	T.
Hightstown	63	22	43.3	4.19	T.
Imlaystown	63	21	42.8	4.61	0.4
Indian Mills	67	18	43.9	4.94	0.8
Jersey City	60	28	44.8	5.34	T.
Lambertville	60	20	42.8	5.73	0.5
Layton	59	13	38.2	5.18	2.0
Long Branch	64	24	45.2	6.17	T.
Moorestown	62	21	43.8	5.49	0.4
Newark	64	23	43.4	5.01	0.2
New Brunswick	64	19	42.2	6.00	1.0
Oceanic	60	24	44.2	5.06	T.
Paterson	62	24	43.8	5.27	0.6
Phillipsburg	59	22	42.0	5.63	2.0
Pleasantville				5.83	2.0
Rancocas				5.37	0.3
Rivervale	65	16[e]	40.6[e]	3.45	2.0
Somerville	60	20	42.6	5.94	1.5
South Orange	60	23	42.2	5.18	1.0
Sussex	59	18	40.9	5.23	1.5
Toms River[m]	63	16	43.6		
Trenton	64	22	45.8	5.52	T.
Tuckerton	64	19	43.9	5.89	3.0
Vineland	64	23	44.5	5.89	T.
Woodbine	65	21	44.9	5.78	2.2
New Mexico.					
Alamogordo	80	23	48.8	0.75	
Albert	79	21	45.3	0.55	2.0
Albuquerque	72[j]	15[j]	43.1[j]	0.42	
Alto				1.06	9.7
Bell Ranch'	72	18	44.7	T.	T.
Bloomfield	68	12	39.4	0.44	1.6
Cambray				1.10	
Carlsbad	75	26	47.3	1.22	
Chama	67	−3	36.7	0.20	2.0
Cimarron	76	10	38.2	0.87	10.0
Cliff				0.67	
Datil	68	12	39.8	0.02	0.5
Deming	80	16	46.6	1.26	
Dulce	70	7	37.6	0.53	5.0
Eagle Rock Ranch	70	6	35.2	0.80	10.0
Elizabethtown	59	0	29.0	0.20	2.0
Elk	72	19	40.9	1.85	T.
Espanola	63	12	38.1	0.14	
Estancia	72	4	36.1	2.11	12.0
Fairview[g]	65	14	38.3		
Fort Stanton	68	17	39.9	0.99	7.5
Fort Union	71	10	35.7	0.66	T.
Fort Wingate	66	12	37.8	0.80	8.0
Fruitland	66	17	39.4	0.20	2.0
Gage	71	21	46.9	1.10	
Glen	77	19	44.0	1.40	3.5
Hillsboro	69	24	44.3	0.83	2.0
Hope				0.96	T.
Lake Valley				0.25	T.
Las Vegas	72	8	37.0	0.77	7.7
Logan	77	14	43.2	0.43	3.0
Lordsburg	80	28	53.9	0.80	
Los Alamos				0.42	
Los Lunas	69	17	42.6	1.38	
Luna				0.75	7.0
Magdalena	65	16	38.4	0.31	4.0
Manuelito				0.90	9.0
Mesilla Park	76	21	49.8	0.93	
Mimbre's				0.92	3.0
Mineral Hill				0.77	10.5
Monument	74	21	47.7	1.50	T.
Mountain Air	69	12	37.2	2.22	24.0
Nara Visa	75	15	43.4	0.55	4.0
Nursery Site	71	6	35.5	0.99	9.0
Orange	72	20	46.6	0.59	
Red River				0.90	9.0
Redrock				1.45	
Rincon	72	20	47.9	0.26	
Rociada	69	2	33.7	0.34	10.0
Rosedale	60	19	38.2	0.65	5.8
San Jon	80	16	44.0	0.66	T.
San Marcial	68	22	46.1	T.	
San Rafael	71	5	39.2	0.82	4.0
Socorro	73	18	44.5	0.95	
Springer	74	9	36.4	0.60	5.0
Strauss				0.60	
Taos	64	10	37.9	0.03	0.3
Tres Piedras	64	2	33.2	0.35	4.0
Valley				0.55	5.5
Vermejo	68	0	34.0	1.15	11.5
Winsor				1.22	
New York.					
Adams	62	20	38.8	4.00	12.0
Addison	64	14	37.8	1.81	0.5

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
New York—Cont'd.					
Allegany	58	4	36.7	2.38	7.4
Amsterdam	55	18	35.7	4.06	8.0
Angelica	56	9	34.4	1.38	2.0
Appleton	57	21	39.2	2.68	
Athens	60	22	39.2	5.00	2.5
Auburn	59	20	37.8	2.30	7.0
Avon	59	19	36.2	2.19	0.2
Baldwinsville	60[d]	21[d]	39.4[d]	2.73	
Ballston Lake	58	19	36.2	3.66	3.2
Bedford	62	11	37.3	6.27	1.0
Blue Mountain Lake				2.65	12.0
Bouckville	52	12	33.1	3.65	8.5
Brockport	60	21	38.0	4.10	3.0
Cape Vincent	56	20	36.6	3.20	1.5
Carmel	58	18	39.2	5.69	1.5
Carvers Falls	58	17	35.2	3.09	5.0
Chatham	59	20	38.4	3.68	2.5
Chazy	55	7	34.3	1.08	7.5
Cooperstown	54	15	34.2	4.01	10.0
Cortland	53	12	34.3	2.86	4.9
Cutchogue	68	26	43.4	6.46	1.0
Dannemora	54	12	33.2	1.21	4.9
De Ruyter	54	7	34.8	3.21	9.4
Easton				3.27	3.0
Elba	62	21	36.1	3.38	3.0
Elmira	59	17	38.8	2.33	
Faust	52	2	31.6	1.51	10.0
Fayetteville	57	18	37.5	3.37	3.0
Fort Plain	56	20	37.8	4.49	6.0
Franklinville	57	5	34.7	2.52	6.2
Glens Falls	56	18	36.2	3.16	3.5
Gloversville	54	16	33.6	4.10	10.3
Greenfield	57	17	35.8	3.72	4.5
Greenwich	59[e]	19[e]	36.4[e]	1.46	2.0
Griffin Corners	57	8	32.7	4.78	4.0
Harkness	57	18	34.3	3.23	9.0
Haskinville				2.96	7.0
Hemlock	56	23	38.2	2.80	T.
Hunt	60	15	37.8	1.15	1.5
Indian Lake	57	7	36.2	5.90	7.5
Ithaca	56	22	38.2	1.92	4.2
Jamestown	59	14	37.4	2.90	11.0
Jeffersonville	58	13	36.2	4.94	6.0
Keene Valley	58	12	33.0	4.99	7.0
Keepawa	55	3	29.4	4.78	25.7
Keuka Park	60	20	37.8	2.56	3.2
Kings Ferry				2.14	4.4
Lake George	57	19	37.1	3.72	3.4
Le Roy	60	21	37.6	3.01	8.1
Liberty	54	17	35.2	3.92	10.0
Little Falls City Res.	56	18	35.3	4.33	5.0
Lockport	56	22	37.9	3.15	0.9
Lowville	56	16	33.8	4.37	5.0
Lyndonville				3.03	T.
Lyons	60	20	39.0	4.51	9.0
Middletown	58	25	40.0	5.02	3.0
Mohonk Lake	56[e]	24[e]	37.4[e]	4.93	2.0
Moira	60	4	34.4	2.55	16.0
Mount Hope	63	19	41.7	7.80	
Newark Valley				2.67	8.0
New Lisbon	56	8	33.0	3.81	11.0
North Hammond	59[e]	12[e]	34.9[e]	2.92	4.5
North Lake	54	10	31.7	4.10	10.0
Norwich	56	16	35.4	3.66	10.6
Ogdensburg				3.22	0.9
Oneonta	61	17	37.5	4.14	10.5
Otto	65	19	37.6	1.11	7.0
Oxford	56	12	36.8	4.15	12.5
Palermo				1.98	4.1
Perry City	56	12	34.6	2.77	7.8
Philadelphia	59	12	35.1	3.45	3.0
Plattsburg	55	9	34.0	1.23	6.8
Port Jervis	59	15	39.0	5.24	8.0
Romulus	60	22	38.4	1.38	4.0
Rose	59	21	38.2	4.76	3.8
Salisbury Mills	62	18	39.2	5.82	0.0
Scarsdale	60	18	40.4	3.33	T.
Setauket	61	26	44.4	6.61	T.
Shortsville	59	21	37.7	2.88	1.0
Skaneateles				3.45	
Southampton	59	23	43.6	6.09	2.0
South Canisteo	58	12	35.6	2.04	2.2
Spier Falls	55	18	35.8	3.68	2.0
Taberg	58	16	36.0	4.46	8.0
Ticonderoga	55	19	37.4	7.95	3.0
Trudeau	52	6	31.2	2.70	9.2
Volusia	55	15	35.6	3.80	8.0
Wading River	60	17	41.6	7.31	T.
Wappinger Falls	60	22	39.7	5.23	3.0
Warwick				5.04	5.0
Watertown	60	19	36.8	3.37	6.0
Waverly	60	13	37.1	2.13	2.8
Wedgwood	56	18	36.1	2.69	6.0
West Berne	57	14	35.8	4.30	8.0
Westfield	57	18	38.0	2.63	7.5
West Point	56	22	39.8	4.61	0.7
Windham	56	9	35.3	4.96	9.7
Youngstown				2.63	0.5

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
North Carolina.					
Banners Elk	64	15	38.6	2.84	2.5
Beaufort	71	35	54.6	4.53	
Brevard	70	16	44.0	6.80	0.5
Brewers	75	20	46.2	4.32	1.0
Caroleen	75	23	47.2	5.81	T.
Chalybeate Springs	79	21	49.0	6.29	
Chapel Hill	77	26	48.0	5.17	
Clinton	80	24	51.8	1.56	
Eagletown	76	26	49.2	5.47	T.
Edenton	72	29	50.0	5.60	
Fayetteville	77	26	51.4	3.52	
Goldsboro	74[i]	27[h]	47.4[h]	4.18	
Greensboro	76	27	47.0	5.54	
Greenville				4.89	
Henderson	75	27	47.6	5.38	T.
Horse Cove	67	22	43.6	9.22	1.0
Hot Springs	78	20	46.6	4.31	
Kinston	79	25	51.2	3.19	
Lexington	75	22	47.2	5.81	
Lincolnton	57	23	42.5	2.30	
Louisburg	74	24	48.1	4.73	T.
Lumberton	79	25	50.8	2.45	
Manteo	70	35	52.5	5.08	
Marion	73	23	46.8	5.24	1.5
Marshall	73	20	46.0	2.36	T.
Moncure	78	20	48.4	4.77	
Monroe	78	19	47.8	5.00	
Morganton	74	20	46.0	4.76	
Mount Airy	70	18	45.4	4.54	2.5
Mount Holly				6.79	
Nashville	75	23	49.0	7.03	T.
New Bern	79	27	51.6	4.51	
Patterson	68	20	42.8	3.00	T.
Pinehurst	77	28	51.2	4.92	
Ramseur	77	18	44.8	5.44	
Reidsville	73	22	46.0	5.51	2.0
Rockingham	75	22	53.2	5.15	
Salem	75	20	45.4	5.26	
Salisbury	78	35	57.6	5.21	
Saxon	72	20	45.0	5.07	
Scotland Neck	76	27	50.9	4.82	
Selma	76[i]	30[i]	50.5[i]	6.74	
Settle	76	16	46.0	4.04	2.3
Snow Hill	78	23	51.2	3.71	
Southern Pines	80	27	51.0	5.60	
Southport	74	31	55.7	2.85	
Tarboro	79	25	50.4	5.08	
Vade Mecum	70	17	44.6	5.93	1.0
Wash Woods	68	32	51.8	5.62	
Waynesville	72	17	44.5	4.52	3.1
Weldon	79	25	48.6	4.94	T.
Willard				3.67	
North Dakota.					
Amenia	55	−1	30.2	0.05	0.5
Aplin	62	9	32.6	0.20	1.5
Beach	68	4	32.0	0.20	0.5
Bottineau	55	−7	26.5	0.04	T.
Buford	64	−1	33.7	T.	T.
Cando	59	−10	26.0	0.15	1.5
Coal Harbor	60	3	31.2	0.20	2.0
Crosby	60	2	29.0	0.15	1.5
Dickinson	68	3	31.8	0.02	T.
Donnybrook	61	−3	28.9	0.05	0.5
Dunseith	58	−6	27.0	T.	T.
Edgeley	58	1	33.0	T.	T.
Forman	74	0	33.4	0.10	1.0
Fort Yates	62	7	35.4	T.	T.
Fullerton	57	−1	30.8	0.03	0.3
Gladys	64	3	30.9	0.10	T.
Glenullen	64[h]	4[h]	31.6[h]	T.	T.
Goforth	61	5	32.4	T.	T.
Granville	60	−1	28.8	T.	T.
Hendley	69	4	35.8	T.	T.
Hillsboro	53	2	30.4	0.09	0.3
Jamestown	56	1	30.6	0.20	2.0
Kulm	55	2	31.8	0.07	0.3
Lakota	52	−5	26.6	0.06	1.7
Lisbon	58	−2	30.6	0.05	0.5
McKinney	58	−3	29.2	0.25	2.5
Manfred	60	−3	29.4	0.30	3.0
Mayville	54	0	30.2	0.19	1.7
Medora	70	2	34.9	0.09	0.2
Melville	58[g]	0[g]	30.1[g]	T.	T.
Minot	56	2	30.4	0.05	0.5
Minto	56	2	29.0	0.13	
Napoleon	61	−2	29.4	0.35	T.
New England	70	1	31.2	T.	T.
New Salem	61	6	33.1	0.02	0.5
Oriska	54	3	30.9	T.	T.
Page	57	−5	30.0	0.05	0.5
Park River	58	1	30.6	0.07	0.7
Pembina	55	0	28.0	T.	T.
Portal	62	−4	27.8	T.	T.
Power	56	−5	29.4	0.10	1.0
Pratt	85	−15	26.8	0.00	
Steele	53[e]	−2[e]	28.4[e]	T.	T.
Towner	60	0	28.8	T.	T.
University	54	−1	29.2	0.05	

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
North Dakota—Cont'd.					
Valley City	57	−3	30.7	0.10	1.0
Walhalla	55	−4	28.2	T.	T.
White Earth.[1]	51	−5	24.0		
Willow City	72	−10	23.3	0.00	
Wishek	60[f]	−4[f]	31.6[f]	T.	T.
Ohio.					
Akron	55	21	38.2	0.84	T.
Amesville	63	14	41.8	1.77	T.
Bangorville	63	21	37.8	2.65	T.
Bellefontaine	65	16	38.2	2.05	T.
Benton Ridge	53	19	38.4	1.90	T.
Bladensburg	56	11	36.4	1.60	
Bowling Green	55	19	38.2	1.89	T.
Bucyrus	57	16	37.4	1.87	
Cadiz	58	21	39.2	1.66	1.0
Cambridge	63	16	39.4	1.65	
Camp Dennison	64	17	40.2	2.09	T.
Canal Dover	56	16	38.0	1.44	T.
Canton	56	20	38.2	1.86	T.
Circleville	60	20	40.2	2.07	
Clarington	60	19	41.0	2.78	T.
Clarksville	60	20	40.8	2.77	T.
Cleveland[b]	56	23	39.2	1.08	1.3
Coalton	64	12	40.1	2.13	0.8
Columbus	59	18	39.2	1.79	
Dayton	60	18	39.8	2.56	0.1
Defiance	55	17	37.6	2.29	0.1
Delaware	58	15	38.3	1.70	T.
Demos	61	21	40.2	1.85	2.0
Findlay	55	16	36.8	2.05	
Frankfort	63	19	41.2	2.13	
Fremont	57	20	39.6	1.77	
Garrettsville	56	15	37.4	2.12	1.0
Granville	57	17	38.6	1.90	T.
Gratiot	58	18	38.4	1.73	T.
Green	67	21	43.0	2.94	T.
Greenhill	57	14	36.1	1.85	0.4
Greenville	56	21	39.5	2.44	T.
Hedges	56	13	37.2	1.93	1.0
Hillhouse	55	16	38.2	2.48	4.0
Hiram	58	21	37.8	2.10	2.0
Hudson	56	15	36.0	1.71	
Ironton	71	17	44.0	2.58	
Jacksonburg	63	21	40.1	3.58	2.0
Kenton	56	20	37.0	2.01	
Killbuck	54	16	38.2	1.75	
Lancaster	63	20	40.4	2.01	T.
Lima	55	18	38.4	2.41	T.
McConnelsville	60	16	40.0	1.38	
Marietta	63	21	42.6	1.67	
Marion	60	16	38.7	2.06	
Medina	58	16	38.0	1.82	T.
Milfordton	59	14	36.8	1.67	
Milligan	60	13	39.0	1.27	
Millport	56	14	37.0	1.55	0.2
Montpelier	54	16	38.0	2.07	1.0
Napoleon	56	19	39.5	1.69	0.5
Nellie	70	14	40.6	0.99	
New Alexandria	65	17	41.2	1.45	2.0
New Berlin	55	18	37.3	1.67	
New Bremen	56	17	39.2	1.88	0.3
New Richmond	62	20	41.4	2.26	T.
New Waterford	56	16	36.8	1.71	0.5
North Lewisburg	55	14	37.4	2.45	
North Royalton	55	20	38.2	1.80	0.5
Norwalk	57	18	37.6	1.55	
Oberlin	59	17	38.4	0.72	T.
Orangeville	56	14	37.2	2.00	1.5
Ottawa	57	15	38.8	2.53	T.
Pataskala	59	17	38.4	2.06	
Philo	61	20	40.5	1.51	
Plattsburg	58	21	38.6	2.68	T.
Pomeroy	65	20	43.1	1.83	
Portsmouth	67	20	42.4	2.59	T.
Pulse				2.46	T.
Rittman	56	17	37.7	1.70	T.
Rockyridge	56	20	39.0	1.91	T.
Rome	56[e]	12[e]	37.7[e]	3.00	4.0
Shenandoah	57	18	37.2	1.47	
Sidney	58	18	39.2	2.33	0.3
Somerset	64	22	41.9	3.01	T.
South Lorain	59	14	38.4	1.42	0.2
Springfield				2.25	T.
Summerfield	62	14	39.0	1.76	T.
Thurman	66	12	43.0	1.91	
Tiffin	54	23	39.2	2.34	T.
Toledo (St. Johns College)	57	22	39.2	1.59	T.
Upper Sandusky	54	19	39.0	1.77	
Urbana	60	15	38.4	2.06	
Vickery	57	18	37.8	1.63	
Warren	58	18	38.4	1.41	T.
Wauseon	55	17	36.9	2.01	1.6
Waverly	67	18	41.8	2.48	T.
Waynesville	59	20	39.8	2.69	T.
Wellington	59	18	38.3	1.42	T.
Willoughby				1.71	1.5
Wilson	65	15	40.2	2.21	
Wooster	55	18	38.5	1.33	T.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
Ohio—Cont'd.					
Zanesville				1.11	T.
Oklahoma.					
Alva	80	16	46.8	0.87	T.
Arapaho	79	14	47.7	1.13	T.
Ardmore	79	18	50.0	2.77	
Buffalo	82	12	48.7	0.55	
Cache	75	15	46.6	1.24	T.
Chandler	80	14	48.8	1.28	
Chattanooga	86[d]	14	48.8[b]	1.23	T.
Cloud Chief	78	14	48.5	1.14	T.
Dacoma	76	16	46.4	1.30	T.
Eldorado	82	14	48.1	0.56	
Erick	80	12	47.6	0.76	T.
Fort Sill				0.70	
Gage	83	8	44.0	0.60	T.
Grand	76	10	45.6	0.56	
Guthrie	76	20	47.3	0.87	
Harrington	78	8	45.9	0.17	T.
Healdton	79	8	47.5	3.03	T.
Hennessey	77[1]	21[b]	47.2[f]	0.72	T.
Hobart	80	17	49.9	0.72	
Hooker	85	10	43.8	0.28	T.
Jefferson	76	20	45.7	1.29	
Kenton	80	6	42.2	0.75	4.0
Kingfisher	77	18	47.8	0.95	
McComb	76	13	47.2	2.10	
Mangum	75	17	49.8	0.80	
Meeker	76	15	45.5	1.65	
Mutual	80	11	46.4	1.00	
Neola	78	16	47.9	1.43	
Newkirk	73	21	47.4	1.34	
Norman				1.33	
Okeene	77	17	47.1	1.10	
Pawhuska	77	16	47.3	1.87	
Perry	78	20	48.6	0.92	
Sac and Fox Agency	77	17	48.9	1.03	
Shawnee	77	18	48.6	2.49	
Snyder	78	16	48.8	0.75	T.
Stillwater	76	21	46.4	0.95	
Temple	89[c]	19	52.2[b]	0.66	
Waukomis	76	16	47.2	0.80	T.
Weatherford	76	12	46.8	0.80	T.
Whiteagle	76	19	47.2	1.03	
Oregon.					
Alba				1.05	
Albany	72	30	47.1		
Ashland	71	28	44.4	1.80	
Astoria	73	38	52.2	10.88	
Aurora (near)	69	31	46.8	6.82	
Bay City	81	32	53.2	13.43	
Bend	68	12	39.4	0.76	T.
Black Butte	60	31	44.5	6.61	
Blalock	64	29	46.8	0.73	
Buckhorn	67	28	45.4	8.25	
Bullrun	65	31	46.2	11.92	
Burns	64	15	37.0	0.51	4.0
Cascade Locks	60	32	46.8	12.53	
Condon	62	22	40.0	0.75	T.
Coquille				6.07	
Corvallis	70	28	46.8	7.92	
Dayville	67	18	41.6	0.60	
Doraville	66	30	46.1	8.09	
Drain	68	34	48.4	5.81	
Echo				0.69	
Ella	68	19	43.3	0.56	
Eugene	65	30	47.6	4.69	
Fairview	70	32	48.8	8.08	
Falls City	71	28	47.1	13.42	
Forest Grove	77	30	46.8	7.68	
Gardiner[a]	65	35	49.4		
Glendale	67	31	46.1	4.28	
Glenora	65	28	45.2	25.40	
Gold Beach	66	32	50.2	6.22	
Grants Pass	65	27	43.9	1.94	
Grass Valley	58	20	40.4	1.46	T.
Heisler	70	15	40.4	0.07	
Heppner	70	24	44.6	0.92	
Hermiston	70[b]	18[c]	44.0[c]	0.69	
Hood River	70	24	42.9	4.55	T.
Huntington	80	25	35.2	0.01	T.
Jacksonville	69	29	43.4	2.19	
Joseph	63	18	37.2	1.22	4.0
Klamath Falls	68	18	39.2	0.21	T.
La Grande	64	21	40.6	3.15	T.
Lakeview	65	16	38.8	1.09	
Lost River	64	18	38.1	0.32	T.
McKenzie Bridge	72	22	42.4	10.76	
McMinnville	68	27	47.0	8.41	
Marshfield	72	31	50.0	7.15	
Monroe	67	28	46.4	7.34	
Mountain Park	64	27	42.3	11.92	1.5
Mount Angel	78	33	51.6	6.50	
Nehalem				17.59	
Newport	71	36	52.2	7.64	
Odell				2.65	T.
Olex (near)	66	26	44.0	0.63	T.
Ontario				0.35	T.
Pendleton	70	23	43.7	1.36	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	*Ins.*	*Ins.*
Oregon—Cont'd.					
Pompeii	61	23	40.0	11.03	42.0
Port Orford	66	39	51.0	7.86	
Prineville	64	18	38.6	0.78	
Riverside	68	12	38.0	0.10	1.0
Salem	69	32	48.1	4.35	
Silver Lake				0.38	
Stafford	70	29	48.0	5.63	
The Dalles	62	27	44.4	2.22	
Toledo	74	31	50.5	7.10	
Umatilla	80	25	45.1	0.89	
Vale	66	12	38.1	0.38	T.
Van				0.41	1.0
Wallowa	64	16	38.0	2.23	T.
Wamic	63[1]	11[1]	40.5[1]	1.81	
Warm Spring	69	16	40.0	0.74	
Wasco				1.70	
Weston	65	26	44.5	3.56	
Yonna				0.37	
Pennsylvania.					
Aleppo	66	13	38.9	2.73	4.0
Altoona	60	15	37.6	3.35	
Baldwin	55	16	36.8	2.44	T.
Bellefonte	60	19	41.4	2.42	......
Browers Lock				7.28	T.
California	68	21	42.6	1.68	T.
Cassandra	60	18	36.6	2.60	3.0
Center Hall	67	17	41.1	2.64	2.0
Clarion				2.21	
Claysville	63	16	39.0	2.08	5.0
Coatsville	63	21	42.6	7.52	4.2
Confluence				3.22	
Davis Island Dam				2.44	
Derry	70	12	40.8	2.88	......
Doylestown				5.89	
Drifton	55	19	39.0	4.25	9.4
Dushore	55	12	36.4	2.68	6.0
East Mauch Chunk	58	18	40.3	5.99	4.5
Easton	58	23	42.2	5.46	1.8
Emporium	57	13	38.0	2.28	1.5
Ephrata	59	19	41.1	4.15	2.0
Everett	63	16	39.3	3.48	6.0
Forks of Neshaminy				5.90	
Franklin	58	12	37.0	2.65	T.
Freeport	63	17	38.4	2.27	T.
George School	61	20	43.0	4.69	1.4
Gettysburg	60	19	41.2	3.72	2.5
Girardville				4.41	12.0
Gordon	60	17	38.9	4.50	......
Greenville	56	16	37.6	2.94	3.5
Grove City	58	15	36.6	1.97	0.4
Hamburg	58	19	39.6	3.02	1.5
Hanover	64	23	44.0	3.65	T.
Herrs Island Dam				2.02	
Huntingdon	60	17	39.8	2.87	1.5
Hyndman	63	16	40.6	4.16	4.0
Indiana	64	18	38.4	2.47	T.
Irwin	68	15	40.5	2.12	T.
Johnstown	64	19	40.2	3.88	T.
Kennett Square	59	22	42.6	5.85	4.0
Lansdale				4.71	
Lawrenceville	58	12	37.0	2.85	
Lebanon	61[f]	24[f]	43.0[f]	4.01	1.5
Le Roy	54	18	37.0	2.79	5.1
Lewisburg	59	20	40.6	2.45	1.0
Lock Haven	60	18	40.6	2.37	1.0
Lock No. 4				1.86	
Lycippus	64	23	40.0	2.77	2.1
Marion	66	20	41.2	3.89	1.0
Mauch Chunk				5.99	
Mifflintown	59	19	40.6	2.85	1.0
Milford	58	14	38.0	5.43	1.5
Montrose	56	9	35.2	3.82	16.0
New Germantown	69	18	41.4	3.66	2.0
Ottsville				5.86	
Philadelphia	60	31	46.2	5.27	T.
Pocono Lake	54	4	32.6	5.29	5.0
Point Pleasant				5.15	
Pottsville				3.55	
Reading	60	24	42.6	5.08	......
Saegerstown	57	12	36.8	3.80	0.5
St. Marys	61	12	37.6	2.43	2.8
Seisholtzville				5.77	
Selinsgrove	65	20	40.8	3.02	1.0
Shawmont				5.84	
Skidmore	57	15	37.0	1.70	T.
Smiths Corners				5.24	
Somerset	62	15	35.6	6.22	7.6
South Eaton	60	17	39.0	3.65	10.0
Springmount				6.27	
State College	56	18	37.9	3.00	4.3
Towanda	59	15	38.0	2.30	3.1
Uniontown	67	19	41.7	3.83	T.
Warren	54	11	36.1	2.98	7.9
Wellsboro	57	13	37.0	2.52	T.
West Chester	63	26	43.0	6.81	2.5
West Newton				1.87	
Wilkes-Barre	60	20	39.8	2.95	6.0
Williamsport	57	22	40.6	2.42	1.2

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Rhode Island.	°	°	°	*Ins.*	*Ins.*
Bristol	59	28	44.2	5.37	T.
Kingston	60	21	41.0	8.03	T.
Providence	......	......	......	5.95	
South Carolina.					
Aiken	76	26	53.6	4.30	
Allendale	76	32	54.4	2.75	
Anderson	87	27	51.2	6.03	
Batesburg	76	29	50.9	3.97	
Beaufort	79	32	57.6	1.92	
Bennettsville	80	27	52.7	3.67	
Blackville	79	29	54.3	3.70	
Bowman	79	28	53.7	2.76	
Calhoun Falls	......	......	......	5.97	
Camden	75	25	50.4	3.96	
Catawba	......	......	......	6.10	
Cheraw	78	26	49.6	4.68	
Clarks Hill	76	26	51.5	4.40	
Clemson College	71	26	49.0	4.85	
Conway	79	28	53.5	2.78	
Dillon	78	24	52.0	2.98	
Edisto	......	......	......	6.96	
Effingham	......	......	......	4.80	
Georgetown	78	32	56.0	2.16	
Greenville	72	26	45.0	6.05	T.
Greenwood	75	28	48.4	8.25	
Heath Spring	72	26	50.3	4.83	
Kingstree	79	28	55.4	2.42	
Liberty	74	25	49.0	6.58	
Little Mountain	78	30	51.2	4.55	
Newberry	77	26	50.2	5.59	
St. George	79	30	55.9	1.74	
St. Matthews	75	31	52.1	5.43	
Saluda	79	24	51.8	4.44	
Santuck	75	26	49.0	7.06	
Smiths Mills	......	......	......	1.37	
Society Hill	75	28	50.5	3.84	
Spartanburg	76	25	48.8	6.44	
Statesburg	75	33	54.2	4.44	
Summerville	83	28	56.2	2.12	
Trenton	75[a]	30[a]	51.6[a]	4.04	
Trial	80	27	54.2	2.13	
Walhalla[b]	75	26	50.0	......	
Walterboro	85	28	57.7	1.55	
Winnsboro	77	30	51.2	2.68	
Winthrop College	75	27[a]	50.0[b]	5.86	
Yemassee	74	29	53.8	1.61	
Yorkville	77	30	50.4	5.52	
South Dakota.					
Aberdeen	64	0	32.2	T.	T.
Academy	63	3	38.6	0.06	0.2
Armour	70	2	33.8	0.02	T.
Ashcroft	70	4	34.6	0.05	0.5
Bowdle	68	6[a]	35.0[b]	0.15	1.5
Brookings	63	−1	33.9	0.10	T.
Castlewood	61	−1	32.5	0.22	1.4
Centerville	64	6	36.2	0.05	0.5
Chamberlain	72	4	39.4	T.	T.
Cherry Creek	70	−2	35.7	T.	T.
Clark	60	2	32.0	0.13	0.7
Clifton	66	0	31.6	T.	T.
De Smet	63	4	35.3	0.10	1.0
Elkpoint	64	10	37.6	T.	T.
Faulkton	61	4	34.0	T.	T.
Flandreau	59	2	32.9	0.08	0.7
Forestburg	64	−2	33.9	T.	T.
Fort Meade	75	5	36.8	0.00	
Frederick	65	−2	32.0	T.	T.
Gannvalley	61[d]	5[d]	36.4[d]	T	T.
Greenwood	70	12	39.6	T.	T.
Hermosa	70	5	37.0	0.02	0.2
Highmore	68	4	35.0	0.05	0.5
Howard	72	−2	33.6	0.15	1.5
Howell	61	0	32.8	0.10	0.1
Ipswich	59	2	31.9	T.	T.
Kennebeck	66	0	36.8	T.	T.
Kidder	60	0	30.8	0.11	1.1
Kimball	68	7	37.2	0.00	
La Delle	63	0	32.7	0.13	0.5
Marion	64	9	36.7	0.05	1.0
Mellette	63	0	33.5	T.	T.
Menno	65	4	36.8	0.02	0.3
Mill Bank	58	2	31.6	0.14	1.2
Mitchell	65	5	36.0	T.	T.
Montrose	63	−4	32.8	0.15	1.5
Mound City	63	1	32.8	T.	T.
Orman	73	1	36.7	T.	T.
Philip	79	2	39.2	0.05	1.0
Redfield	64	2	32.3	T.	T.
Rosebud	68[b]	5[b]	35.4[b]	0.05	T.
Roslyn	56	3	31.6	0.04	0.5
Selby	69	6	34.8	T.	T.
Sioux Falls	60	8	35.5	0.05	0.5
Spearfish	69	6	37.9	0.08	T.
Stephan	69	0	34.6	T.	T.
Vermillion	62	11	38.0	0.25	T.
Wentworth	62	5	34.2	0.08	0.8
Wessington Springs	62	4	36.4	T.	T.
Woolsey				T.	T.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Tennessee.	°	°	°	*Ins.*	*Ins.*
Ashwood	79	21	46.6	4.52	
Benton	72	20	47.6	4.87	T.
Bluff City	......	......	......	4.58	
Bolivar	75	22	46.8	4.57	
Bristol	68	20	43.3	4.72	T.
Brownsville	74	25	48.8	3.19	
Byrdstown	76	20	47.4	5.36	T.
Carthage	73	20	46.8	4.97	
Cedar Hill	74	23	46.8	5.00	T.
Celina	......	......	......	5.61	
Clarksville	73	21	45.6	4.58	T.
Clinton	......	......	......	6.38	
Covington	75	23	47.8	4.60	
Dandridge	......	......	......	5.16	
Decatur	73	18	47.0	6.40	1.0
Dickson	74	20	46.4	5.03	
Dover	73	19	46.7	3.99	
Dyersburg	75	24	47.6	5.00	
Elizabethton	68	21	43.5	3.15	T.
Erasmus	70	14	42.2	5.00	0.5
Florence	72	22	46.4	4.63	T.
Franklin	72	22	45.6	5.93	
Harriman	69	23	46.3	5.96	T.
Hohenwald	76	17	46.6	4.46	
Iron City	75	17	46.2	5.65	
Jackson	76	21	49.7	3.58	
Johnsonville	75	19	46.2	4.62	
Jonesboro	68	20	44.7	3.61	T.
Kenton	76	21	48.2	4.15	T.
Lafayette	73	20	45.0	......	T.
Lewisburg	75	19	46.4	5.04	T.
Loudon	......	......	......	6.55	T.
Lynnville	72	21	47.8	5.39	
McMinnville	72	18	45.8	4.76	0.4
Maryville	70	21	46.7	5.62	1.5
Milan	70	23	46.2	4.60	
Newport	68	24	46.0	4.46	
Palmetto	77	20	48.9	4.52	T.
Pinewood	75[e]	17[e]	44.3[e]	4.76	
Pope	78	16	46.4	......	
Rogersville	69	19	45.6	5.06	T.
Rugby	72	12	40.4	4.19	1.5
Savannah[c]	75	20	46.5	......	
Sevierville	71	19	46.2	5.44	
Sewanee	68	21	45.1	5.65	
Silver Lake	62	19	40.8	4.70	1.5
Sparta	72	18	45.4	3.75	0.5
Springdale	75	17	44.0	6.07	1.0
Springville	74	19	45.8	4.51	T.
Tellico Plains	75	20	48.1	5.41	0.5
Tracy City	77	21	45.0	......	T.
Trenton	74	21	47.3	4.68	
Tullahoma	71	18	45.6	5.83	T.
Union City	76[a]	20[a]	45.2[a]	4.87	
Waynesboro	74	19	46.4	5.98	T.
Wildersville	71	22	46.7	4.18	
Yukon	72	24	47.6	5.77	
Texas.					
Albany	80	19	52.2	2.25	
Alvin	......	......	......	7.54	
Austin	77	30	55.0	7.99	
Ballinger	78	21	48.8	2.80	
Barstow	72	34	51.4	1.22	T.
Beaumont	......	......	......	4.69	
Beeville	88	33	56.8	3.55	
Big Spring	78	20	50.0	1.37	T.
Blanco	80	22	51.6	7.48	
Boerne	76	22	51.8	10.40	
Bonham	77	14	50.2	4.38	T.
Booth	......	......	......	9.06	
Bowie	78	18	51.8	2.69	T.
Brazoria	83	30	60.0	9.71	
Brenham	79	29	56.4	9.63	
Brighton	85	35	61.5	6.04	
Brownsville	86	36	63.3	2.24	
Canadian	79	15	46.4	0.71	
Carmona	81	21	55.7	9.94	
Channing	76	17	46.3	0.29	2.5
Childress	79	17	49.0	1.21	
Chillicothe	......	......	......	0.80	
Clarendon	76	14	46.5	0.76	T.
Clarksville	83	19	54.1	4.13	
Claytonville	85	16	49.0	1.94	2.0
Coleman	78	21	52.8	4.73	
College Station	79	27	55.6	13.06	T.
Colorado	79	16	50.4	1.93	2.5
Columbia	81	27	57.5	11.12	
Corsicana	83	25	55.2	6.36	
Crockett	80	22	55.1	13.60	T.
Cross Bar Ranch	......	......	......	0.40	
Cuero	78	29	56.8	8.33	
Dalhart	75	15	45.4	0.40	4.0
Dallas	80	15	51.4	6.93	
Danevang	83	30	57.4	14.12	
Denison	......	......	......	6.23	
Dialville	77	23	52.8	10.12	T.
Dublin	76	30	52.2	5.17	T.
Duval	78	28	55.4	9.26	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Texas—Cont'd.	°	°	°	*Ins.*	*Ins.*
Eagle Pass	82	33	56.9	2.93	
Earls Ranch	......	......	......	6.82	T.
Encinal	86	39	66.6	2.21	
Falfurrias	90	36	63.6	1.52	
Fort Clark	76	29	53.6	5.25	
Fort McIntosh	87	32	60.2	2.20	
Fort Stockton	77	25	51.6	1.73	0.5
Fredericksburg	76	25	52.1	6.37	1.0
Gainesville	75	22	52.0	3.25	
Gatesville	76	19	52.6	5.95	T.
Georgetown	80	23	54.8	10.18	
Grapevine	83[a]	19[a]	54.2[a]	3.82	T.
Greenville	77	20	51.9	3.69	
Hallettsville	79	30	57.8	6.76	
Haskell	80	21	50.5	2.19	1.2
Hebbronville	......	......	......	1.59	
Hempstead	......	......	......	9.90	
Henrietta	82	23	50.4	2.41	
Hereford	......	......	......	0.71	7.5
Hondo	77	31	54.9	6.86	
Houston	84	29	57.0	10.30	
Jewett	78	19	53.2	9.38	
Junction	......	......	......	5.46	
Kaufmann	77	19	53.1	6.42	
Keene	79	21	53.3	5.81	
Kerrville	77	25	51.8	8.38	
Knickerbocker	77	24	51.0	2.18	T.
Lampasas	79	20	51.0	6.20	
Lapara	......	......	......	1.45	
Laureles Ranch	......	......	......	4.57	
Liberty	84	33	58.0	6.75	
Llano	80	18	54.4	4.30	
Longview	79	22	51.6	10.89	
Lufkin	82	20	54.4	11.21	
Luling	81	27	55.4	7.60	
McLean	76	12	45.6	0.43	T.
Memphis	80	15	49.0	0.56	
Mexia	78	22	52.6	7.46	T.
Miami	78	9	44.7	0.58	T.
Mount Blanco	77	16	46.2	1.10	T.
Nacogdoches	79	21	52.8	10.39	T.
Nazareth	74	16	44.2	0.59	
New Braunfels	79	28	57.3	9.28	
Panter	......	......	......	5.74	0.1
Paris	79	17	51.6	5.75	
Pierce	......	......	......	10.04	
Plemons	78	7	42.4	0.65	1.0
Port Lavaca	82	34	60.4	9.57	
Quanah	78	18	52.0	T.	T.
Rossville	......	......	......	7.24	T.
Runge	......	......	......	5.67	
Sabinal	83	27	57.0	4.00	
San Angelo	78	25	49.6	2.61	T.
San Antonio	80	27	56.4	6.78	
San Saba	78	19	51.8	5.73	
Santa Gertrudes	......	......	......	3.97	
Seymour	79	18	49.8	2.35	T.
Sherman	......	......	......	2.78	
Sonora	79	27	51.3	3.84	
Sugarland	84	28	57.2	11.81	
Sulphur Springs	79	20	52.6	6.66	T.
Temple	78	19	51.4	7.25	
Tulia	......	......	......	1.00	2.0
Victoria	86	32	59.0	7.41	
Waco	78	29	53.6	6.54	
Waxahachie	81	14	51.2	5.86	
Wharton	82	30	58.0	9.77	
Wichita Falls	79	19	54.3	1.94	
Wills Point	75	19	51.8	5.35	
Utah.					
Alpine	......	......	......	0.63	7.0
Annabella	......	......	......	0.50	5.0
Beaver	65	11	38.2	0.25	2.5
Castle Dale	66	12	36.4	0.47	......
Cedar City	64	19	41.0	0.20	T.
Corinne	69	17	41.4	0.21	1.0
Coyoto	66	10	37.0	......	......
Deseret	64	11	35.8	0.20	4.0
Emery	73	17	41.4	0.10	1.0
Escalante	66	15	39.0	0.19	......
Experiment Farm	73	19	45.4	......	......
Farmington	60	23	39.4	0.58	5.8
Fillmore	75	21	43.8	0.25	......
Fort Duchesne	76	70	33.8	0.23	1.5
Garrison	69	9	37.4	0.49	......
Government Creek	62	16	37.2	0.37	......
Grantsville	......	......	......	0.55	......
Grayson	63	15	39.0	0.75	5.0
Green River	63	15	37.1	0.20	......
Heber	63	8	34.5	0.33	5.5
Henefer	67	9	34.6	0.20	1.5
Hite	73	24	47.6	0.45	......
Huntsville	......	......	......	0.32	
Kanosh	......	......	......	0.49	
Kelton	60	11	35.6	T.	T.
Levan	60	13	36.1	0.36	3.6
Loa	56	−8	26.8	......	......
Logan	58	21	37.6	0.13	......

TABLE II.—*Climatological record of cooperative observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Utah—Cont'd.	°	°	°	*Ins.*	*Ins.*
Marion				0.73	8.9
Marysvale	67	8	36.2	0.02	0.2
Meadowville	57	12	32.0	0.10	0.4
Milford	64	13	35.8	0.40	2.5
Millville				0.35	
Minersville				0.26	1.5
Moab	68	16	40.3	0.27	T.
Morgan	65	10	36.2	0.42	4.0
Mount Nebo	64	17	37.0	0.53	3.0
Mount Pleasant	69	10	37.8	0.28	2.8
Nephi				0.66	6.0
Oak City	67	19	38.4	0.12	
Ogden	59	21	39.6	0.48	3.5
Park City	60	7	31.2		
Parowan	64	14	39.1	0.32	
Payson				0.55	1.0
Plateau	63	−6	34.8	0.77	8.2
Provo	64	19	37.6	0.30	3.0
Ranch	65	11	37.0	0.35	4.0
Randolph				0.20	2.0
Richfield	79[h]	5[h]	33.1[h]	0.32	3.2
St. George	78	22	49.8	0.00	
Saltair	54	14	33.8	0.52	2.0
Scipio	65	9	30.7	0.28	2.0
Snowville	66	8	36.8	0.15	
Soldier Summit	55[f]	6[f]	31.4[f]	0.30	8.0
Springdale	79	23	48.9	0.10	
Sunnyside				0.80	8.0
Theodore	64	9	33.4	0.29	3.0
Thistle	68	8	38.6	0.60	6.0
Tooele	60	22	39.8	0.62	
Tropic	67[e]	15[e]	39.0[e]	T.	T.
Trout Creek	65	10	36.0	T.	T.
Verdure				0.47	5.5
Wellington				0.40	4.0
Woodruff	66	1	30.6	0.20	4.0
Vermont.					
Bloomfield	56	8	32.3	2.42	4.0
Cavendish				3.89	5.5
Chelsea	58	8	30.6	3.20	5.0
Enosburg Falls	61	2	34.3	2.55	12.5
Jacksonville	54	14	32.7	6.42	14.0
Manchester	58	17	35.9	3.76	3.5
Norwich				2.97	4.5
St. Johnsbury	59	10	33.4	2.47	5.5
Wells	52	16	33.8	3.39	4.0
Woodstock	52	6	31.4	3.79	5.0
Virginia.					
Arvonia	69	17	45.0	5.00	0.5
Ashland	66	24	46.0	4.44	T.
Bigstone Gap	67	19	45.2	8.35	2.0
Blacksburg	66	18	41.0	4.97	1.5
Burkes Garden	61	13	38.2	5.13	2.0
Charlottesville	71	27	46.4	5.69	0.4
Clarksville				5.74	
Columbia	67	22	45.1	5.88	T.
Culpeper	64	20	43.2	4.57	T.
Dale Enterprise	66	17	41.4	4.15	2.0
Dinwiddie	73	19	46.4	4.32	T.
Doswell	67	23	46.6	5.51	T.
Elk Knob	63	22	43.2	7.22	2.0
Galax				1.10	2.0
Hampton	71	32	50.1	5.99	
Hot Springs	63	18	40.2	4.17	
Ivanhoe				3.61	
Lexington	67	19	42.1	5.14	0.2
Lincoln	69	18	43.0	4.17	T.
Marion	64	19	42.5	2.94	T.
Max Meadows	60	18	41.5	3.31	2.0
Newport News	74	34	50.3	5.09	T.
Nokesville (near)	65	25	44.0	4.14	T.
Petersburg	70	26	47.7	4.24	T.
Quantico	68	19	42.6	4.83	
Roanoke	70[d]	21[d]	45.6[d]	4.49	T.
Rocky Mount	70	19	44.8	4.91	T.
Saxe	75	19	48.0	5.30	
Shenandoah				3.83	T.
Speers Ferry				7.30	1.0
Spottsville	75	23	48.2	4.81	T.
Staunton	65	23	44.5	4.03	T.
Stephens City	67	18	42.8	3.61	3.0
Warsaw	69	24	45.7	5.29	
Williamsburg	72	23	47.8	5.70	T.
Woodstock	66	20	43.0	3.23	2.7
Washington.					
Aberdeen	66	32	48.4	13.27	
Anacortes	63	32	47.0	4.23	
Baker	69	31	45.8	9.81	T.
Bellingham	65	31	48.0	4.76	
Blaine	62	29	45.9	7.86	T.
Cedar River				7.26	
Centralia	65	30	46.5	8.04	
Cheney	65	21	41.6	1.05	1.0
Clearbrook	64	30	45.8	8.24	
Clearwater	62	34	47.7	26.22	
Cle Elum	63	17	37.8	4.71	7.0
Colfax	64	16	41.9	1.44	
Coleville	58	17	37.1	1.62	1.5

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Washington—Cont'd.	°	°	°	*Ins.*	*Ins.*
Conconully	57	19	36.9	0.87	0.5
Coupeville	64	34	48.0	2.13	
Crescent	56	20	38.2	1.36	1.0
Cusick	55	18	37.3	2.17	7.0
Dayton	63	26	44.3	2.14	
Detroit	62	31	47.3	9.89	
East Sound	60	29	43.8	4.54	
Ellensburg	62	18	38.6	0.66	
Ephrata	78	25	45.2	0.50	
Gardena	70	21	47.9	2.25	
Hatton	69	17	42.4	0.89	
Huntsville				1.72	
Kennewick	65	19	44.0	0.21	
Kiona	68	16	44.2	0.50	
Kosmos	69	31	45.8	9.34	
Lacenter	65	28	44.4	7.28	
Lakeside	60	29	41.2	1.24	2.0
Lester	68	30	43.2	8.60	4.0
Mottinger Ranch	69	28	45.9	0.81	
Mount Pleasant	61	31	47.6	9.33	
Moxee	66	17	41.4	0.46	T.
Northport	54	10	34.9	1.79	5.0
Olga	61	34	46.7	4.46	
Olympia	64	31	46.4	10.47	
Pinehill	61	26	43.0	4.69	T.
Pomeroy	69	21	43.0	0.75	
Port Townsend	58	37	47.2	1.49	
Pullman	59	21	41.6	1.52	T.
Quiniault	59	34	46.6	23.65	
Rattlesnake	70	19	43.9	0.81	0.5
Rex Creek				4.40	
Ritzville				1.41	
Rock Lake	63[g]	19[g]	41.5[g]	1.67	T.
Rosalia	63	15	40.2	1.75	
Sedro-Woolley	62	28	45.8	7.62	
Sixprong	66	25	44.5	0.50	
Snohomish	68	29	45.9	5.44	
Snoqualmie	64	31	45.3	7.99	
South Bend	66	36	50.2		
Stehekin	56	25	39.5	5.47	13.0
Sunnyside	63	19	42.4	0.19	
Twisp	61	12	36.8	1.07	10.8
Vancouver	71	31	47.4	5.77	
Vashon	60	33	47.4	8.01	
Wahluke	63	20	41.8	0.27	
Waterville	68	18	37.2	0.76	2.5
Wenatchee (near)	59	26	40.6	1.14	2.5
Westport				8.89	
Wilbur	62	22	39.0	1.27	T.
Yale	71	32	48.4	15.49	
Zindel	75	28	46.2	0.85	
West Virginia.					
Bancroft	72	20	43.4	2.51	T.
Bayard	63	13	36.7	4.82	8.0
Beckley	70	20	41.6	5.93	T.
Bens Run	64	20	41.4	2.50	T.
Burlington	65	14	41.0	3.48	4.0
Cairo	65	15	41.6	4.21	
Central Station	67	13	39.5	3.24	T.
Charleston	70	22	46.9	3.98	
Creston	66	16	41.9	2.05	
Cuba	67	15	41.2	2.40	T.
Doane	74	25	46.8	2.51	T.
Elkhorn	66	22	44.0	4.53	3.0
Faust	73	18	42.5	3.89	T.
Franklin	65	18	41.7	2.97	T.
Glenville	69	17	43.1	2.25	
Grafton	67	19	42.0	3.92	1.0
Green Sulphur Springs	67	19	41.0	3.95	
Hinton				4.03	
Huntington	69	20	41.5	2.82	T.
Lewisburg	65	18	40.7	4.50	T.
Logan	74	25	48.0	5.70	T.
Lost City	62	20	42.4	2.21	3.0
Lost Creek	68	13	40.6	3.52	T.
Mannington	67	15	40.0	3.04	1.0
Martinsburg	62	20	40.6	3.88	
Moorefield	72	15	42.7	2.40	4.0
Morgantown	65	19	41.6	3.05	T.
Moundsville	66	19	42.0	1.81	T.
New Cumberland	59	14	38.1	2.20	
New Martinsville	68	20	42.6	2.71	
Nuttallburg	58	15	30.8	3.48	
Oceana				5.64	
Parsons	69	14	39.2	4.50	T.
Philippi	68	14	40.8	3.12	0.2
Pickens	63	18	37.0	5.42	3.0
Point Pleasant	67	21	44.2	2.47	
Powellton	71	22	45.0	3.07	T.
Princeton	63	15	38.2	5.45	4.5
Romney	64	16	40.2	2.37	3.0
Ryan	70	14	42.4	2.65	T.
Smithfield	64	20	40.5	3.25	2.0
Southside	69	16	42.6	1.89	T.
Spencer	68	14	40.0	1.41	
Sutton	74	18	43.1	5.01	T.
Terra Alta	58	18	39.2	4.77	9.0
Union	64	13	38.2	3.94	T.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
West Virginia—Cont'd.	°	°	°	*Ins.*	*Ins.*
Uppertract	67	17	42.2	2.35	T.
Valley Fork	71	14	45.0	2.40	T.
Webster Springs	70	20	42.8	5.42	
Wellsburg	58	22	39.0	2.42	4.5
Weston	68[e]	16[e]	40.2[e]	3.14	T.
Wheeling	67	19	42.4	1.62	T.
Williamson				3.01	T.
Wisconsin.					
Amherst	58	9	33.8	1.60	T.
Antigo[f]	50	5	31.3		
Appleton	52	11	35.2	1.53	T.
Appleton Marsh	51	7	33.4	1.32	1.0
Ashland	55	10	34.9	0.49	0.5
Beloit	60	15	38.2		1.0
Brodhead	56	10	36.2	1.38	1.2
Burnett	56	11	34.6	2.07	0.3
Butternut	49	8	29.8	0.68	
Cecil	53	11	34.0	1.58	T.
Chilton	48	12	34.1	1.55	T.
Cranden	52	6	30.0	0.20	T.
Delavan	55	10	35.8	1.00	2.0
Dodgeville	52[e]	19[e]	36.1[e]	0.79	1.0
Downing	56	4	32.4	1.00	T.
Eau Claire	56	8	34.2	1.33	3.1
Florence	49	9	29.3	0.82	2.0
Grand Rapids	53	7	33.4	1.11	T.
Grand River Locks				1.30	T.
Grantsburg	54	3	31.8	1.00	4.0
Hancock	50	7	33.0	0.80	T.
Hayward	53[d]	2[d]	31.2[d]	0.75	1.0
Hillsboro	54	5	33.1	1.12	1.5
Koepenick	50	1	28.6	0.70	5.0
Lake Mills	52	13	35.0	1.50	1.5
Lancaster	58	10	35.1	0.68	3.0
Manitowoc	54	13	36.8	1.45	T.
Mauston	55	9	34.9	1.42	1.0
Meadow Valley	56	6	33.0	1.12	0.1
Medford	52	6	31.4	0.80	4.0
Menasha				1.50	T.
Merrill	50	5	31.0	0.73	1.5
Minocqua	49	3	29.8	0.75	4.0
Mount Horeb	51	8	34.4	1.76	2.0
Neillsville	54	7	32.6	0.70	1.0
New London	50	9	34.2	2.02	T.
New Richmond	54	5	33.1	1.37	1.0
Oconto	51	11	34.2	1.70	T.
Osceola	56	4	32.6	1.12	T.
Oshkosh	54	14	34.8		
Pine River	51	6	34.1	1.41	0.1
Portage	51	10	35.4	0.85	T.
Port Washington	50	18	35.2	1.58	1.0
Prairie du Chien	57	11	37.0	1.28	2.0
Prentice	52	0	29.8	1.09	5.2
Racine	56	16	38.2	1.24	
Sheboygan	51	16	37.2	1.63	0.5
Shullsburg	53	10	34.7	1.63	1.5
Spooner	51	8	30.7	0.56	1.0
Stanley	52	4	32.3	1.15	3.5
Stevens Point	52	5	32.4	1.18	
Sturgeon Bay	51	10	35.2	2.26	T.
Valley Junction	52	5	32.8	1.29	2.0
Viroqua	50	10	34.6	1.80	5.0
Watertown	51	10	33.5	1.39	0.1
Waukesha	52	12	35.5	1.48	0.9
Waupaca	57	8	33.6	1.26	T.
Weyerhauser	53	4	31.3	0.90	2.3
Whitehall[e]	58	6	35.0		
Wyoming.					
Afton	60	10	32.6	0.32	4.5
Barnum				0.60	6.0
Basin	63	7	33.2	0.07	
Bedford	60	11	31.9	0.56	5.4
Blue Cap	52	0	25.4	0.38	3.5
Border	59	5	30.2	0.09	2.0
Buffalo	67	4	36.5	0.60	6.0
Camp Colter	64	6	35.4	0.25	2.5
Chugwater	68	−5	33.9	0.30	3.0
Clark	64	15	39.0	0.49	5.0
Clear Creek Cabin	58	−3	28.6	0.54	10.0
Daniel	57	−5	26.6	T.	T.
Dubois	59	−5	27.4	T.	T.
Eatons Ranch				1.30	13.0
Elk Mountain				0.03	0.5
Evanston	65	12	32.8	0.05	0.5
Experiment Farm				0.16	6.0
Fayette	57	−5	27.2	0.05	1.0
Fontenelle	58	0	26.2	T.	T.
Fort Laramie	74	−14	33.2	0.14	4.0
Granite Canyon	60	−8	32.0	0.30	3.0
Granite Springs	59	0	34.2	0.39	4.5
Green River	61	3	31.6	0.09	1.9
Griggs	71	−1	32.8	0.55	4.5
Hyattville	67	4	35.1		
Kinnear	65	1	32.0	0.16	4.0
Kirtley	68	1	32.8	0.16	
Kirwin	53	0	26.2	1.01	14.5
Lake	46	5	24.0	0.71	7.5
Laramie	61	−7	30.0	T.	T.

TABLE II.—*Climatological record of cooperative observers*—Continued. *Late reports for October, 1907.*

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Wyoming—Cont'd.	°	°	°	*Ins.*	*Ins.*
Leo	58	— 7	30.9	0.12	0.8
Lusk	68	— 2	33.4	0.00	
Moorcroft	68	— 1	38.2	0.20	2.0
Moore	64	— 1	35.2	0.34	3.0
Newcastle	60	6	30.4	T.	T.
Norris	50	— 4	25.6	0.82	6.5
Pathfinder	62	0	34.0	0.02	0.2
Phillips	70	— 3	35.4	0.30	3.0
Pine Bluff	79	— 2	36.6	0.80	8.0
Pinedale	53	2	27.0	T.	T.
Rawlins	68	7	34.3	0.07	0.8
Riverside	52	0	25.1	0.40	4.0
Riverton	67	3	30.0	0.50	4.0
Saratoga	62	— 4	32.0	T.	T.
Sheridan	70	1	34.1	0.45	4.0
Shoshone	66	14	37.7	0.35	3.5
Sunshine	......	......	......	0.50	5.0
Thermopolis	63	3	32.5	0.29	3.0
Wells	51	—13	21.8	0.89	10.0
Wheatland	74	3	40.6	0.40	5.0
Worland	70	11	35.1	0.30	3.0
Wyncote	70[1]	4	38.0[f]	0.20	2.0
Yellowstone Pk. (Soda B.)	68	— 5	27.2	0.40	4.0
Yellowstone Pk. (S. Pass)	62	9	32.7	0.35	......
Yellowstone Pk. (Up. Ba.)	52	4	28.2	0.51	6.0
Porto Rico.					
Aguirre	98	65	80.2	0.90	
Albonito	88	46	72.3	2.54	
Alto de La Bandera	84[d]	63	72.8[b]	3.00	
Anasco	93	63	78.5	4.51	
Arecibo	90	58	74.4	9.39	
Barros	84	58	71.0	4.28	
Bayamon	93[f]	67[f]	79.4[f]	......	
Caguas	91	59	75.1	3.14	
Canovanas	87	65	78.0	5.85	
Cayey	86	54	71.8	1.26	
Cidra	89	61	74.8	2.52	
Coloso	90	67	78.7	6.38	
Corozal	90	60	76.2	7.69	
Culebra	85	70	78.2	4.37	
Fajardo	90	68	79.0	5.85	
Guanica	95	58	77.0	4.55	
Guayama	......	......	......	0.56	
Humacao	89	64	76.7	2.30	
Ingenio	......	......	......	3.72	
Isabela	91	68	79.4	4.68	
Isolina	88	61	73.4	9.77	
Juana Diaz	92[1]	66[1]	78.6[1]	3.24	
La Carmelita	88	62	74.1	7.67	
La Playa Sardinera	93	67	78.4	......	
Lares	91	60	74.3	3.51	
Las Marias	85	58	72.8	10.48	
Manati	86	63	75.4	7.29	
Maricao	87	60	74.0	8.58	
Maunabo	91	67	80.5	2.85	
Mayaguez	90	62	77.2	4.83	
Porto Rico—Cont'd.	°	°	°	*Ins.*	*Ins.*
Ponce	92	64	79.0	3.46	
Rio Blanco	95	61	76.9	4.74	
Rio Piedras	......	......	......	5.53	
Sabana Grande	......	......	......	20.04	
San German	90	63	76.8	8.86	
San Lorenzo	95	54	74.4	2.89	
San Salvador	87	60	73.6	4.88	
San Sebastin	......	......	......	4.00	
Santa Isabel	93[e]	64[e]	78.2[e]	2.60	
Vieques	90	70	79.4	3.19	
Yauco	91	60	76.2	7.45	
New Brunswick.					
St. John	56	17	36.3	5.10	0.3

Late reports for October, 1907.

Stations.	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Alaska.	°	°	°	*Ins.*	*Ins.*
Cilliachaket	38	—41	10.8	0.70	11.5
Coal Harbor	52	23	39.0	5.83	T.
Dutch Harbor	51	28	40.0	7.79	1.0
Fort Egbert	......	......	......	1.12	13.0
Fort Gibbon	......	......	......	1.22	12.0
Fort Liscum	50	10	35.6	16.77	10.4
Holy Cross Mission	43	—10	22.2	0.38	......
Katalla	54	22	40.9	25.62	1.2
Kenai	55	— 1	31.2	1.66	2.7
Loring	63	30	45.6	20.09	
Nome	44	3	24.5	0.16	1.7
Rampart	35	—28	15.1	0.65	7.5
Sunrise	55	6	34.2	6.08	14.2
Tyonok	57	5	34.8	3.48	4.7
Wood Island	56	16	40.7	8.70	......
California.					
Bakersfield	100	40	65.0	0.20	
Hanford	96	35	62.0	0.64	
Jamestown	86	40	60.6	1.20	
Laytonville	......	......	......	1.12	
Tejon Ranch	......	......	......	1.96	
Idaho.					
Soldier[f]	76	23	49.1	......	
Indiana.					
Hammond	83	31	50.7	1.34	
Scotsburg	89	30	56.4	......	
Montana.					
Homepark	......	......	......	0.85	
Ovando	78	18	45.4	0.01	
Valentine	84	21	50.8	T.	
Nevada.					
Geyser	......	......	......	1.42	
New York.					
Chazy	68	22	43.8	2.06	T.
Romulus	79	24	47.7	1.27	T.
West Point	68	30	45.4	7.51	
North Carolina.	°	°	°	*Ins.*	*Ins.*
Selma	82	37	57.4	0.22	
North Dakota.					
Flasher	84	9	44.2	0.89	......
Hannah	78[c]	8[c]	40.2[c]	T.	T.
Oregon.					
McMinnville	80	35	55.8	1.96	
Texas.					
Haskell	......	......	......	4.25	
Utah.					
Thistle	80	24	54.0	......	
Washington.					
East Sound	68	29	50.2	0.59	

CORRECTIONS.

Tennessee: Elizabethton, precipitation thruout the year 1907 unreliable, therefore discarded.

June, 1907.

Tennessee: Milan, make precipitation 3.36.

October, 1907.

New York: Appleton, make mean temperature 46.7.

EXPLANATION OF SIGNS.

* Extremes of temperature from observed readings of dry thermometer.

A numeral following the name of a station indicates the hours of observation from which the mean temperature was obtained, thus:

[1] Mean of 7 a. m. + 2 p. m. + 9 p. m. + 9 p. m. ÷ 4.
[2] Mean of 8 a. m. + 8 p. m. ÷ 2.
[3] Mean of 7 a. m. + 7 p. m. ÷ 2.
[4] Mean of 6 a. m. + 6 p. m. ÷ 2.
[5] Mean of 7 a. m. + 2 p. m. ÷ 2.
[6] Mean of readings at various hours reduced to true daily mean by special tables.

The absence of a numeral indicates that the mean temperature has been obtained from daily readings of the maximum and minimum thermometers.

An italic letter following the name of a station, as "Livingston *a*," "Livingston *b*," indicates that two or more observers, as the case may be, are reporting from the same station. A small roman letter following the name of a station, or in figure columns, indicates the number of days missing from the record; for instance, "n" denotes 14 days missing.

No note is made of breaks in the continuity of temperature records when the same do not exceed two days. All known breaks of whatever duration, in the precipitation record receive appropriate notice.

TABLE III.—*Wind resultants, from observations at 8 a. m. and 8 p. m., daily, during the month of November, 1907.*

Stations.	Component direction from— N.	S.	E.	W.	Resultant. Direction from—	Duration.
	Hours.	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
New England.						
Eastport, Me	13	20	6	29	s. 73 w.	24
Portland, Me	19	17	7	29	n. 85 w.	22
Concord, N. H. †	16	5	7	9	n. 10 w.	11
Burlington, Vt. †	8	15	8	6	s. 16 e.	7
Northfield, Vt	18	32	4	15	n. 38 w.	18
Boston, Mass	16	18	10	28	s. 84 w.	18
Nantucket, Mass	19	18	18	19	n. 45 w.	1
Block Island, R. I	21	16	16	22	n. 50 w.	8
Providence, R. I	21	12	11	31	n. 66 w.	22
Hartford, Conn	22	21	6	23	n. 87 w.	17
New Haven, Conn	29	9	11	21	n. 27 w.	22
Middle Atlantic States.						
Albany, N. Y	22	24	7	16	s. 77 w.	9
Binghamton, N. Y. †	5	5	13	12	e.	1
New York, N. Y	17	10	15	27	n. 60 w.	14
Harrisburg, Pa	17	10	14	28	n. 63 w.	16
Philadelphia, Pa	25	16	13	23	n. 48 w.	14
Scranton, Pa	19	18	14	22	n. 83 w.	8
Atlantic City, N. J	23	15	10	25	n. 62 w.	17
Cape May, N. J	25	15	10	19	n. 42 w.	14
Baltimore, Md	24	8	15	26	n. 34 w.	19
Washington, D. C	31	8	10	23	n. 29 w.	26
Lynchburg, Va	19	16	14	25	n. 75 w.	11
Mount Weather, Va	19	18	15	26	n. 85 w.	11
Norfolk, Va	23	20	12	15	n. 45 w.	4
Richmond, Va	22	20	12	18	n. 72 w.	6
Wytheville, Va	8	9	13	38	s. 88 w.	25
South Atlantic States.						
Asheville, N. C	29	14	14	18	n. 15 w.	16
Charlotte, N. C	24	16	18	18	n.	8
Hatteras, N. C	26	12	17	21	n. 16 w.	15
Raleigh, N. C	26	15	11	21	n. 42 w.	15
Wilmington, N. C	25	15	14	18	n. 22 w.	11
Charleston, S. C	28	13	16	14	n. 8 e.	15
Columbia, S. C	31	11	16	16	n.	20
Augusta, Ga	25	14	13	23	n. 42 w.	15
Savannah, Ga	27	12	12	19	s. 25 w.	17
Jacksonville, Fla	32	16	12	13	n. 3 w.	16
Florida Peninsula.						
Jupiter, Fla	18	19	23	13	s. 84 e.	10
Key West, Fla	26	9	35	4	n. 61 e.	35
Tampa, Fla	28	11	22	13	n. 28 e.	19
Eastern Gulf States.						
Atlanta, Ga	28	11	11	26	n. 42 w.	23
Macon, Ga. †	16	4	7	8	n. 5 w.	12
Thomasville, Ga	24	12	13	21	n. 34 w.	14
Pensacola, Fla. †	20	1	7	5	n. 6 e.	19
Anniston, Ala	29	15	16	10	n. 23 e.	15
Birmingham, Ala	32	11	12	16	n. 11 w.	21
Mobile, Ala	38	8	10	15	n. 9 w.	30
Montgomery, Ala	29	13	13	15	n. 7 w.	16
Meridian, Miss	32	10	14	18	n. 10 w.	22
Vicksburg, Miss	28	10	20	11	n. 27 e.	20
New Orleans, La	34	11	21	7	n. 31 e.	27
Western Gulf States.						
Shreveport, La	25	14	20	12	n. 36 e.	14
Bentonville, Ark. †	7	12	7	8	s. 11 w.	5
Fort Smith, Ark	19	19	20	17	e.	3
Little Rock, Ark	18	16	13	24	n. 80 w.	11
Corpus Christi, Tex	42	9	17	7	n. 17 e.	34
Fort Worth, Tex	18	23	13	20	s. 54 w.	9
Galveston, Tex	32	8	20	9	n. 25 e.	26
Palestine, Tex	25	16	22	6	n. 61 e.	18
San Antonio, Tex	35	8	25	6	n. 35 e.	33
Taylor, Tex. †	14	8	4	8	n. 34 w.	7
Ohio Valley and Tennessee.						
Chattanooga, Tenn	24	17	10	26	n. 66 w.	18
Knoxville, Tenn	24	16	16	20	n. 27 w.	9
Memphis, Tenn	22	21	11	18	n. 32 w.	13
Nashville, Tenn	21	11	11	30	n. 62 w.	22
Lexington, Ky. †	5	10	5	14	s. 61 w.	10
Louisville, Ky	17	20	7	33	s. 83 w.	26
Evansville, Ind. †	14	5	4	11	n. 38 w.	11
Indianapolis, Ind	19	19	12	20	w.	8
Cincinnati, Ohio	15	16	16	26	s. 84 w.	10
Columbus, Ohio	18	20	13	26	s. 81 w.	13
Pittsburg, Pa	23	13	11	27	n. 58 w.	19
Parkersburg, W. Va	13	19	10	28	s. 72 w.	19
Elkins, W. Va	15	17	9	29	s. 84 w.	20
Lower Lake Region.						
Buffalo, N. Y	14	20	11	26	s. 68 w.	16
Canton, N. Y. †	3	10	6	17	s. 58 w.	13
Oswego, N. Y	14	30	12	17	s. 17 w.	17
Rochester, N. Y	9	23	8	33	s. 61 w.	29
Syracuse, N. Y	10	30	10	22	s. 31 w.	23
Erie, Pa	7	31	12	24	s. 27 w.	27
Cleveland, Ohio	10	31	16	22	s. 16 w.	22
Sandusky, Ohio †	3	12	3	18	s. 59 w.	18
Toledo, Ohio	12	23	6	33	s. 68 w.	29
Detroit, Mich	12	19	10	32	s. 72 w.	23
Upper Lake Region.						
Alpena, Mich	15	21	5	34	s. 78 w.	30
Escanaba, Mich	24	15	4	31	n. 72 w.	28
Grand Haven, Mich	20	16	14	25	n. 70 w.	12
Grand Rapids, Mich	15	19	11	25	s. 74 w.	15
Houghton, Mich. †	12	4	7	12	n. 32 w.	9
Marquette, Mich	17	19	4	33	s. 86 w.	29
Port Huron, Mich	10	23	7	32	s. 63 w.	28
Sault Sainte Marie, Mich	13	16	24	20	s. 53 e.	5
Chicago, Ill	16	16	7	34	w.	27
Milwaukee, Wis	18	14	4	36	n. 83 w.	32
Green Bay, Wis	16	21	7	33	s. 79 w.	26
Duluth, Minn	18	14	5	38	n. 83 w.	33
North Dakota.						
Moorhead, Minn	20	23	5	25	s. 81 w.	20
Bismarck, N. Dak	26	16	7	30	n. 67 w.	25
Devils Lake, N. Dak	17	20	6	29	s. 83 w.	23
Williston, N. Dak	13	30	6	23	s. 45 w.	24
Upper Mississippi Valley.						
Minneapolis, Minn. *	......	......	......	......	......	......
St. Paul, Minn	21	20	11	24	n. 86 w.	13
La Crosse, Wis. †	11	15	2	4	s. 27 w.	4
Madison, Wis	16	22	9	26	s. 71 w.	18
Charles City, Iowa	19	19	11	30	w.	19
Davenport, Iowa	15	13	10	35	n. 85 w.	25
Des Moines, Iowa	19	18	9	29	n. 87 w.	20
Dubuque, Iowa	22	17	6	29	n. 78 w.	24
Keokuk, Iowa	17	16	15	28	n. 86 w.	13
Cairo, Ill	25	19	10	17	n. 49 w.	9
La Salle, Ill. †	6	8	5	16	s. 80 w.	11
Peoria, Ill	20	15	10	26	n. 73 w.	17
Springfield, Ill	16	18	12	27	s. 82 w.	15
Hannibal, Mo. †	8	8	4	18	w.	14
St. Louis, Mo	21	16	15	23	n. 58 w.	9
Missouri Valley.						
Columbia, Mo. *	8	5	8	15	n. 67 w.	8
Kansas City, Mo	18	17	12	26	n. 86 w.	14
Springfield, Mo	20	17	14	19	n. 59 w.	6
Iola, Kans. †	11	8	7	13	n. 68 w.	7
Topeka, Kans. *	12	7	7	10	n. 31 w.	6
Lincoln, Nebr	23	21	10	16	n. 27 w.	13
Omaha, Nebr	21	17	6	28	n. 80 w.	22
Valentine, Nebr	24	9	5	33	n. 62 w.	32
Sioux City, Iowa †	14	6	7	12	n. 32 w.	9
Pierre, S. Dak	24	17	16	24	n. 49 w.	11
Huron, S. Dak	20	21	9	22	s. 86 w.	13
Yankton, S. Dak. †	8	4	4	20	n. 76 w.	16
Northern Slope.						
Havre, Mont	13	14	8	39	s. 88 w.	31
Miles City, Mont	......	......	......	......	......	......
Helena, Mont	7	25	2	40	s. 65 w.	42
Kalispell, Mont	17	17	6	33	w.	27
Rapid City, S. Dak	......	......	......	......	......	......
Cheyenne, Wyo	24	9	7	35	n. 62 w.	32
Lander, Wyo	14	25	18	12	s. 29 e.	12
Sheridan, Wyo	15	25	19	25	s. 31 w.	12
Yellowstone Park, Wyo	11	35	2	26	s. 45 w.	34
North Platte, Nebr	17	10	9	35	n. 75 w.	27
Middle Slope.						
Denver, Colo	13	34	13	9	s. 11 e.	21
Pueblo, Colo	20	14	24	18	n. 45 e.	8
Concordia, Kans	18	19	7	25	s. 87 w.	18
Dodge, Kans	23	14	14	21	n. 38 w.	11
Wichita, Kans	27	17	14	17	n. 17 w.	10
Oklahoma, Okla	24	26	7	12	s. 68 w.	5
Southern Slope.						
Abilene, Tex	22	27	9	15	s. 50 w.	8
Amarillo, Tex	20	27	6	10	s. 30 w.	8
Del Rio, Tex. †	11	6	13	7	n. 50 e.	8
Roswell, N. Mex	29	19	11	12	n. 6 w.	10
Southern Plateau.						
El Paso, Tex	24	5	21	22	n. 3 w.	19
Santa Fe, N. Mex	24	14	35	4	n. 72 e.	33
Flagstaff, Ariz	23	15	19	17	n. 14 e.	8
Phoenix, Ariz	16	8	26	19	n. 41 e.	11
Yuma, Ariz	37	3	18	14	n. 7 e.	34
Independence, Cal	22	14	6	31	n. 72 w.	26
Middle Plateau.						
Reno, Nev	13	15	13	30	s. 83 w.	17
Tonopah, Nev	7	24	14	28	s. 39 w.	22
Winnemucca, Nev	26	13	26	16	n. 38 e.	16
Modena, Utah	5	10	23	30	s. 54 w.	9
Salt Lake City, Utah	15	26	24	13	s. 45 e.	16
Durango, Colo	26	16	4	27	n. 67 w.	25
Grand Junction, Colo	12	12	19	29	w.	10
Northern Plateau.						
Baker City, Oreg	10	34	17	13	n. 9 e.	24
Boise, Idaho	12	18	26	18	s. 53 e.	10
Lewiston, Idaho †	2	8	20	4	s. 69 e.	17
Pocatello, Idaho	6	26	18	25	s. 19 w.	21
Spokane, Wash	15	26	17	11	s. 29 e.	12
Walla Walla, Wash	2	45	10	16	s. 8 w.	43
North Pacific Coast Region.						
North Head, Wash	13	28	17	16	s. 4 e.	15
Port Crescent, Wash. *	3	16	9	12	s. 13 w.	13
Seattle, Wash	13	32	20	7	s. 34 e.	28
Tacoma, Wash	6	33	10	29	s. 35 w.	33
Tatoosh Island, Wash	7	27	20	14	s. 17 e.	21
Portland, Oreg	11	25	15	24	s. 33 w.	17
Roseburg, Oreg	17	20	18	18	s.	3
Middle Pacific Coast Region.						
Eureka, Cal	21	17	17	13	n. 45 e.	6
Mount Tamalpais, Cal	29	8	14	22	n. 21 w.	22
Red Bluff, Cal	39	4	4	31	n. 38 w.	44
Sacramento, Cal	24	15	14	21	n. 38 w.	11
San Francisco, Cal	20	8	5	38	n. 70 w.	35
San Jose, Cal. †	20	0	1	21	n. 45 w.	28
Southeast Farallon, Cal. *	19	1	2	20	n. 45 w.	26
South Pacific Coast Region.						
Fresno, Cal	13	14	19	27	s. 83 w.	8
Los Angeles, Cal	24	8	19	25	n. 21 w.	17
San Diego, Cal	34	3	18	21	n. 6 w.	31
San Luis Obispo, Cal	35	8	7	20	n. 26 w.	30
West Indies						
San Juan, Porto Rico	8	30	30	5	s. 47 e.	33

* From observations at 8 p. m. only. † From observations at 8 a. m. only.

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TABLE IV.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded 0.25 in any 5 minutes, or 0.80 in 1 hour, during November, 1907, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Abilene, Tex	28			0.17														0.12			
Albany, N. Y	2			0.77														0.49			
Alpena, Mich	20-21			0.52														0.13			
Amarillo, Tex	18-19			0.66														0.09			
Anniston, Ala	20			0.85														0.46			
Asheville, N. C	20-21			0.63														0.19			
Atlanta, Ga	10			1.10														0.46			
Atlantic City, N. J	18-19			0.98														0.42			
Augusta, Ga	21			0.59														0.29			
Baltimore, Md	2			0.82														0.30			
Bentonville, Ark	19-20			1.26														0.19			
Binghamton, N. Y	2			0.70														0.40			
Birmingham, Ala	1-2	6:40 p. m.	6:02 a. m.	0.74	11:26 p. m.	11:36 p. m.	0.06	0.19	0.30												
Bismarck, N. Dak	9-10			0.26														*			
Block Island, R. I	6			2.10														0.65			
Boise, Idaho	16-17			0.46														*			
Boston, Mass	24-25			2.94														0.62			
Buffalo, N. Y	5			0.32									0.31								
Cairo, Ill	1			1.77														0.32			
Canton, N. Y	6-7			1.55														0.35			
Charles City, Iowa	20			0.59														0.20			
Charleston, S. C	28-29			0.73														0.32			
Charlotte, N. C	18			0.94														0.31			
Chattanooga, Tenn	22-23			1.00														0.39			
Cheyenne, Wyo	18			0.57														*			
Chicago, Ill	20			0.99														0.31			
Cincinnati, Ohio	1-2			1.22														0.21			
Cleveland, Ohio	1-2			0.78														0.13			
Columbia, Mo	20			1.10														0.26			
Columbia, S. C	22-23			1.41														0.61			
Columbus, Ohio	1-2			1.03														0.13			
Concord, N. H	2-3			1.45														0.44			
Corpus Christi, Tex	1	5:15 p. m.	7:10 p. m.	0.50	5:26 p. m.	5:41 p. m.	0.01	0.21	0.38	0.43											
Davenport, Iowa	20-21			0.85														0.19			
Del Rio, Tex	10			0.66														0.52			
Denver, Colo	18			0.33														*			
Des Moines, Iowa	20			0.87														0.14			
Detroit, Mich	20-21			0.43														0.17			
Dodge, Kans	19			0.14														*			
Dubuque, Iowa	20			0.84														0.16			
Duluth, Minn	1			0.31														*			
Eastport, Me	3			0.61														0.37			
Elkins, W. Va	23-24			0.84														0.26			
Erie, Pa	2-3			0.42														*			
Escanaba, Mich	20-21			0.98														0.18			
Evansville, Ind	1-2			2.42														0.36			
Fort Smith, Ark	19-20			1.21														0.17			
Fort Worth, Tex	16-17			1.94														0.33			
Galveston, Tex	16-17	7:07 p. m.	10:30 a. m.	2.66	6:02 a. m.	6:30 a. m.	0.39	0.34	0.70	1.12	1.58	1.95	2.06								
Grand Haven, Mich	20-21			1.07														0.31			
Grand Rapids, Mich	20-21			1.11														0.28			
Green Bay, Wis	20			0.68														*			
Hannibal, Mo	20			1.06														0.29			
Harrisburg, Pa	2			0.85														0.48			
Hartford, Conn	6-7			2.00														*			
Hatteras, N. C	6	12:55 a. m.	9:25 a. m.	1.93	12:59 a. m.	2:19 a. m.	0.01	0.15	0.19	0.27	0.38	0.40	0.40	0.42	0.50	0.58	0.60	0.77	1.26		
Huron, S. Dak	3			T.																	
Indianapolis, Ind	20			0.84														0.31			
Iola, Kans	19-20			1.25														0.15			
Jacksonville, Fla	28	8:50 p. m.	D. N. p. m.	0.64	9:38 p. m.	10:02 p. m.	0.07	0.08	0.16	0.26	0.38	0.48									
Jupiter, Fla	5-6			0.87														0.50			
Kansas City, Mo	19-20			1.09														0.17			
Keokuk, Iowa	20			0.96														*			
Key West, Fla	2	1:00 a. m.	6:20 a. m.	0.96	3:15 a. m.	3:41 a. m.	0.08	0.19	0.30	0.41	0.51	0.58									
Knoxville, Tenn	9-10			1.55														0.49			
La Crosse, Wis	20			0.75														0.17			
La Salle, Ill	20			0.98														0.24			
Lexington, Ky	1-2			1.02														0.17			
Lincoln, Nebr	19-20			0.25														*			
Little Rock, Ark	19-20			5.91														0.70			
Los Angeles, Cal	7			T.																	
Louisville, Ky	1-2			1.73														0.26			
Lynchburg, Va	18			1.12														0.22			
Macon, Ga	20-21			1.09														0.43			
Madison, Wis	20			0.93														0.15			
Marquette, Mich	27-28			0.62														*			
Memphis, Tenn	19-20			2.52														0.43			
Meridian, Miss	20	9:00 a. m.	12:45 p. m.	0.82	10:23 a. m.	10:29 a. m.	0.19	0.35	0.39												
Milwaukee, Wis	20			0.56														0.14			
Minneapolis, Minn	1			0.59														*			
Mobile, Ala	22	6:45 a. m.	11:50 a. m.	4.75	7:20 a. m. 8:10 a. m. 9:00 a. m. 9:50 a. m.	8:10 a. m. 9:00 a. m. 9:50 a. m. 10:21 a. m.	0.05	0.14 1.69 2.60 3.82	0.26 1.73 2.66 3.99	0.48 1.81 2.71 4.30	0.71 1.83 2.78 4.45	1.04 1.84 2.83 4.51	1.38 1.89 2.90 4.57	1.50 1.94 3.06	1.58 2.01 3.32	1.65 2.21 3.48	1.67 2.46 3.64				
Montgomery, Ala	21-22	5:00 p. m.	5:10 p. m.	4.13	5:57 a. m.	6:27 a. m.	2.15	0.07	0.20	0.24	0.41	0.48	0.53								
Mount Weather, Va	23-24			1.18														*			
Nantucket, Mass	18-19			1.70														0.50			
Nashville, Tenn	1-2			1.49														0.46			
New Haven, Conn	6-7			2.61														0.38			
New Orleans, La	17	11:20 a. m.	4:45 p. m.	1.34	3:07 p. m.	3:17 p. m.	0.82	0.26	0.48												
Do	21-22	11:35 a. m.	9:10 a. m.	1.90	7:47 a. m.	8:17 a. m.	0.10	0.11	0.24	0.39	0.51	0.64	0.73								
New York, N. Y	6-7			1.90														0.34			
Norfolk, Va	23-24			1.75														0.35			
Northfield, Vt	2-3			0.78														0.35			
North Head, Wash	21			0.71														0.29			
Oklahoma, Okla	19-20			0.76														0.23			
Omaha, Nebr	19-20			0.40									0.04								
Palestine, Tex	16-17	1:14 p. m.	10:00 a. m.	4.33	3:40 a. m.	4:40 a. m.	1.45	0.06	0.12	0.18	0.25	0.42	0.55	0.72	0.85	0.95	1.05	1.19			
Parkersburg, W. Va	1-2			0.72									0.10								
Pensacola, Fla	22	12:10 p. m.	4:55 p. m.	1.13	12:29 p. m.	1:24 p. m.	0.02	0.21	0.33	0.34	0.35	0.36	0.48	0.66	0.82	0.88	0.95	1.01			
Peoria, Ill	20			1.21														*			

TABLE IV.—*Accumulated amounts of precipitation for each 5 minutes, etc.*—Continued.

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Philadelphia, Pa.	6			1.04														0.39			
Pittsburg, Pa.	6			0.37														0.15			
Portland, Me	6			1.36														0.46			
Portland, Oreg	23–24			1.72														0.37			
Pueblo, Colo	10			0.02														*			
Raleigh, N. C	22	D. N.	10:45 a. m.	2.25	4:16 a. m.	5:16 a. m.	0.05	0.06	0.16	0.23	0.25	0.27	0.30	0.40	0.70	0.95	1.13	1.31			
Richmond, Va	2			0.80														0.30			
Rochester, N. Y.	6–7			1.51														0.11			
Sacramento, Cal	16			0.04									0.03								
St. Louis, Mo	27			0.22														0.20			
St. Paul, Minn	1			0.81														0.21			
Salt Lake City, Utah	21			0.23														*			
San Antonio, Tex	9	11:40 a. m.	3:15 p. m.	1.13	12:03 p. m.	12:31 p. m.	0.01	0.09	0.38	0.59	0.74	0.89	0.94								
San Diego, Cal.	6			0.05				0.05													
Sandusky, Ohio	1–2			1.10														0.22			
San Francisco, Cal	1			0.02					0.02												
Savannah, Ga	28–29			1.01														0.32			
Scranton, Pa	2–3			0.65														0.33			
Seattle, Wash	23			0.82														0.29			
Shreveport, La	19–20			3.59														0.72			
Spokane, Wash	23			0.30														0.08			
Springfield, Ill	20			1.10														0.37			
Springfield, Mo	19–20			1.20														*			
Syracuse, N. Y	6–7			1.05														*			
Tampa, Fla	29	11:36 a. m.	1:27 p. m.	1.17	12:20 p. m.	12:45 p. m.	0.07	0.25	0.52	0.64	0.77	0.92									
Taylor, Tex.	9	9:00 a. m.	12:45 p. m.	0.95	9:22 a. m.	9:37 a. m.	0.02	0.11	0.41	0.55											
Thomasville, Ga.	23	12:15 p. m.	5:50 p. m.	1.30	5:04 p. m.	5:34 p. m.	0.33	0.27	0.47	0.58	0.71	0.83	0.94								
Toledo, Ohio	1–2			1.06														0.29			
Topeka, Kans	19–20			1.12														0.14			
Valentine, Nebr	18–19			0.03														*			
Vicksburg, Miss	22			1.88														0.34			
Washington, D. C	2			0.76														0.29			
Wichita, Kans	19–20			0.79														0.11			
Wytheville, Va.	2			0.64									0.18								
Yankton, S. Dak	10			0.01														*			
San Juan, P. R.	29–30			0.99														0.60			

* Self-register not working. † No precipitation during the month.

TABLE V.—*Data furnished by the Canadian Meteorological Service, November, 1907.*

Stations.	Pressure, in inches.			Temperature.				Precipitation.		
	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Total.	Departure from normal.	Total snowfall.
	Ins.	Ins.	Ins.	°	°	°	°	Ins.	Ins.	Ins.
St. Johns, N. F	29.92	30.06	+.12	37.8	+ 1.3	43.8	31.8	6.16	+0.59	
Sydney, C. B. I.	30.05	30.09	+.14	39.5	+ 2.4	46.0	33.0	5.44	0.00	4.0
Halifax, N. S.	29.96	30.07	+.06	39.0	+ 1.7	46.2	31.7	6.05	+0.39	2.0
Grand Manan, N. B	29.97	30.02	+.01	40.7	+ 1.8	46.0	35.5	4.71	−0.91	T.
Yarmouth, N. S	29.98	30.05	+.03	40.0	+ 0.1	46.1	34.0	5.27	+0.71	1.5
Charlottetown, P. E. I	30.00	30.04	+.08	37.4	+ 1.9	42.8	32.1	1.62	−2.35	0.6
Chatham, N. B	30.00	30.02	+.05	34.6	+ 3.6	42.4	26.8	4.62	+0.87	2.2
Father Point, Que	30.01	30.03	+.07	31.0	+ 2.1	37.4	24.6	1.63	−1.48	4.8
Quebec, Que	29.66	30.00	−.02	30.9	+ 1.9	35.7	26.2	3.84	+0.08	10.2
Montreal, Que	29.79	30.01	−.02	33.4	+ 1.6	38.2	28.5	3.96	+0.22	14.2
Rockliffe, Ont.	29.38	30.01	.00	28.2	− 0.9	35.4	21.1	3.45	+0.87	7.0
Ottawa, Ont	29.74	30.08	+.06	33.0	+ 1.3	37.7	28.3	4.28	+1.74	7.2
Kingston, Ont.	29.72	30.04	.00	36.0	+ 1.0	42.0	30.1	2.17	−1.07	3.4
Toronto, Ont	29.63	30.02	−.02	36.9	+ 1.3	42.7	31.2	3.51	+0.37	0.9
White River, Ont										
Port Stanley, Ont	29.40	30.06	+.01	36.8	0.0	43.6	29.9	1.92	−1.45	0.4
Saugeen, Ont										

Stations.	Pressure, in inches.			Temperature.				Precipitation.		
	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Total.	Departure from normal.	Total snowfall.
	Ins.	Ins.	Ins.	°	°	°	°	Ins.	Ins.	Ins.
Parry Sound, Ont	29.29	30.00	−.01	33.1	+ 1.0	39.6	26.6	3.79	−0.58	18.5
Port Arthur, Ont.	29.28	30.01	+.01	28.8	+ 4.8	36.4	21.2	1.05	−0.28	1.1
Winnipeg, Man	29.16	30.02	−.02	25.5	+ 7.5	34.7	16.2	0.72	−0.36	5.5
Minnedosa, Man	28.14	30.01	−.03	24.9	+ 7.6	34.7	15.1	0.36	−0.64	3.2
Regina, Sask	27.95			27.2	+ 8.4	40.1	14.4	0.27	−0.62	2.6
Medicine Hat, Alberta	27.64	29.95	−.05	37.3	+ 9.9	48.1	26.6	0.01	−0.91	T.
Swift Current, Sask	27.40	30.03	+.01	31.7	+ 8.5	44.1	19.3	0.16	−0.53	1.6
Calgary, Alberta	26.36	29.95	−.03	34.5	+ 8.7	45.7	23.3	0.08	−0.80	0.8
Banff, Alberta	25.35	30.03	+.07	31.0	+ 2.2	37.4	24.5	1.22	−1.05	11.1
Edmonton, Alberta	27.57	29.90	−.07	33.8	+19.9	42.4	25.3	0.11	−0.47	T.
Prince Albert, Sask	28.32	29.92	−.11	25.8	+10.4	35.7	15.9	0.15	−0.68	1.1
Battleford, Sask	28.16	29.93	−.09	28.3	+12.0	38.9	17.7	0.01	−0.57	T.
Kamloops, B. C.	28.80	30.04	+.08	41.6	+ 8.2	47.7	35.5	0.57	−0.39	
Victoria, B. C.	29.99	30.09	+.10	47.4	+ 4.2	51.8	42.8	4.68	−2.29	
Barkerville, B. C.	25.60	29.97	+.07	28.7	+ 5.1	35.2	22.1	4.04	+0.75	8.0
Hamilton, Bermuda	29.96	30.12	+.07	68.8	+ 0.1	74.1	63.6	1.76	−2.62	
Dawson, Yukon										

TABLE VI.—*Heights of rivers referred to zeros of gages, November, 1907.*

Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
	Miles.	Feet.	Feet.		Feet.		Feet.	Feet.
Republican River.								
Clay Center, Kans.	42	18	5.7	29, 30	5.2	1-5	5.4	0.5
Smoky Hill-Kansas River.								
Abilene, Kans.	254	22	0.4	10	0.0	1, 3, 6-8, 12-17, 20-23	0.1	0.4
Manhattan, Kans	160	18	2.9	30	2.5	18	2.7	0.4
Topeka, Kans.	87	21	5.3	1-13, 21, 22	5.1	15-19	5.2	0.2
Missouri River.								
Bismarck, N. Dak.	1,309	14	2.5	8, 9	1.2	16	1.9	1.3
Pierre, S. Dak.	1,114	14	1.1	1-4	— 0.9	24	0.5	2.0
Sioux City, Iowa	784	17	6.5	1-7	5.7	28-30	6.2	0.8
Blair, Nebr.	705	15	6.0	2	4.7	30	5.5	1.3
Omaha, Nebr.	669	18	8.0	1-3, 8-12	7.0	30	7.8	1.0
St. Joseph, Mo	481	10	1.5	3	0.4	19, 20	0.9	1.1
Kansas City, Mo.	388	21	7.6	4, 6	6.5	30	7.1	1.1
Glasgow, Mo.	231	18	5.2	2, 4, 8, 12	4.7	23, 27	5.0	0.5
Boonville, Mo.	199	20	8.1	6-8	7.6	19, 22-24, 29, 30	7.8	0.5
Hermann, Mo.	103	24	6.1	8, 9	5.6	24, 25	5.8	0.5
Minnesota River.								
Mankato, Minn	127	18	3.0	4-6	2.0	1, 16	2.4	1.0
St. Croix River.								
Stillwater, Minn.	23	11	4.5	9, 10	3.6	1, 2, 28-30	3.9	0.9
Illinois River.								
La Salle, Ill.	197	18	14.6	23-25, 27	13.3	18-20	14.0	1.3
Peoria, Ill.	135	14	10.6	28-30	9.8	21	10.3	0.8
Conemaugh River.								
Johnstown, Pa.	64	7	5.5	7	1.4	1, 2, 28-30	2.5	4.1
Allegheny River.								
Warren, Pa.	177	14	4.2	8	0.9	22-28	1.9	3.3
Parker, Pa.	73	20	5.8	4,5	1.5	19, 20, 26, 27	2.8	4.3
Freeport, Pa.	29	20	10.7	5	3.0	25	5.5	7.7
Youghiogheny River.								
Confluence, Pa.	59	10	5.0	7	0.8	2	2.1	4.2
West Newton, Pa.	15	23	7.1	8	1.4	18	3.0	5.7
Monongahela River.								
Fairmont, W. Va.	119	25	19.5	25	15.0	18	16.5	4.5
Greensboro, Pa.	81	18	13.4	7	7.8	18	9.7	5.6
Lock No. 4, Pa.	40	28	17.4	8	8.5	18	11.8	8.9
Muskingum River.								
Zanesville, Ohio	70	25	11.0	5	8.0	19, 20	8.6	3.0
Little Kanawha River.								
Creston, W. Va.	38	20	12.2	25	2.8	19	4.3	9.4
New-Great Kanawha River.								
Hinton, W. Va.	153	14	5.5	25	1.7	1	2.9	3.8
Charleston, W. Va.	58	30	12.3	11	4.0	18	7.6	8.3
Scioto River.								
Columbus, Ohio	110	17	4.8	4	1.8	28-30	2.7	3.0
Licking River.								
Falmouth, Ky.	30	25	6.0	26	0.5	1	2.8	5.5
Kentucky River.								
Beattyville, Ky	254	30	6.0	25	0.2	1	1.6	5.8
Frankfort, Ky.	65	31	9.3	26	4.7	1	6.7	4.6
Wabash River.								
Mount Carmel, Ill.	75	15	6.0	5	1.8	1	3.9	4.2
Cumberland River.								
Burnside, Ky.	518	50	16.0	25	— 0.1	1	5.2	16.1
Celina, Tenn.	383	45	16.8	27	1.2	1	7.3	15.6
Carthage, Tenn.	308	40	13.0	27, 28	0.9	1	6.0	12.1
Nashville, Tenn.	193	40	17.0	29	7.2	1, 2	11.2	9.8
Clarksville, Tenn.	126	43	17.4	29	1.6	1	8.7	15.8
Clinch River.								
Speers Ferry, Va.	156	20	12.0	11	— 0.4	1	2.3	12.4
Clinton, Tenn	52	25	21.5	12	3.0	1	9.0	18.5
South Fork Holston River.								
Bluff City, Tenn.	35	12	3.9	11	1.0	1, 2	2.0	2.9
Holston River.								
Rogersville, Tenn.	108	14	5.3	11, 25	1.7	1, 2	3.1	3.6
French Broad River.								
Asheville, N. C.	144	4	2.9	24	— 0.7	1, 2	0.1	3.6
Dandridge, Tenn.	46	12	4.1	25	0.6	1, 2	1.5	3.5
Tennessee River.								
Knoxville, Tenn.	635	12	7.6	25	0.9	1, 2	2.9	6.7
Loudon, Tenn.	590	25	7.5	25	1.0	9	3.0	6.5
Kingston, Tenn.	556	25	9.8	26	1.7	1	4.7	8.1
Chattanooga, Tenn.	452	33	13.6	26	2.0	2	6.3	11.6
Bridgeport, Ala	402	24	10.7	26	0.9	2	4.4	9.8
Guntersville, Ala.	349	31	16.3	27	2.3	5	7.3	14.0
Florence, Ala.	255	16	9.2	28	0.3	1	3.7	8.9
Riverton, Ala.	225	26	14.2	29	1.8	1	6.3	12.4
Johnsonville, Tenn.	95	21	13.0	30	1.4	1	5.4	11.6
Ohio River.								
Pittsburg, Pa.	966	22	11.7	8	3.4	16	6.8	8.3
Dam No. 2, Pa.	956	25	11.9	8	3.9	18	6.8	8.0
Beaver Dam, Pa.	925	27	16.9	8	6.1	18	9.7	10.8
Wheeling, W. Va.	875	36	16.4	9	5.7	19	9.4	10.7
Parkersburg, W. Va.	785	36	15.2	6	7.0	20, 21	10.0	8.2
Point Pleasant, W. Va.	703	39	19.1	12	5.9	20	11.7	13.2
Huntington, W. Va	660	50	23.5	12	9.4	1	15.7	14.1
Catlettsburg, Ky.	651	50	24.0	12	8.0	1	15.5	16.0
Portsmouth, Ohio	612	50	23.7	13	8.4	1	15.7	15.3
Maysville, Ky.	559	50	23.2	13	6.2	1	15.3	17.0
Cincinnati, Ohio	499	50	23.9	15	7.1	1	17.0	16.8
Madison, Ind	413	46	20.0	15	6.3	1, 2	14.4	13.7
Louisville, Ky.	367	28	9.3	15	3.4	1	6.8	5.9
Evansville, Ind	184	35	17.3	17	5.3	1	11.7	12.0
Mount Vernon, Ind.	148	35	17.3	19	4.2	1	11.0	13.1
Paducah, Ky.	47	40	14.7	20	3.6	1	9.6	11.1
Cairo, Ill.	1	45	18.6	20, 21	9.5	1	14.4	9.1
Neosho River.								
Iola, Kans.	262	10	1.0	1	0.0	9-12	0.2	1.0
Oswego, Kans.	184	20	2.4	23	0.3	19	0.8	2.1
Neosho River.—Cont'd.								
Fort Gibson, Okla.	3	22	8.9	20-23	8.7	1, 2, 17-19, 30	8.8	0.2
Canadian River.								
Calvin, Okla.	99	10	3.6	28	2.8	16-19	3.2	0.8
Black River.								
Blackrock, Ark.	67	12	8.1	21	2.2	1	3.5	5.9
White River.								
Calicorock, Ark	272	18	0.6	21	— 0.6	12-17	—0.2	1.2
Batesville, Ark.	217	18	4.3	20	1.4	15-18	2.0	2.9
Clarendon, Ark.	75	30	17.3	27	7.3	1, 3-5, 14-17	10.0	10.0
Arkansas River.								
Wichita, Kans.	832	10	— 1.5	1-10	— 1.7	13-19, 29, 30	—1.6	0.2
Tulsa, Okla.	551	16	3.8	3	2.7	16-19	3.1	1.1
Webbers Falls, Okla.	465	23	6.4	27-30	2.0	1	5.1	4.4
Fort Smith, Ark.	403	22	3.2	25	2.0	18-20	2.3	1.2
Dardanelle, Ark.	256	21	2.5	9	1.4	2	2.1	1.1
Little Rock, Ark.	176	23	7.6	22	2.2	7, 19	3.3	5.4
Pine Bluff, Ark.	121	25	10.3	23	4.4	5-8	6.0	5.9
Yazoo River.								
Greenwood, Miss	175	38	4.7	29, 30	1.7	1	2.8	3.0
Yazoo City, Miss.	80	25	0.9	30	— 1.9	6-8	—1.0	2.8
Ouachita River.								
Camden, Ark.	304	39	29.7	25	3.7	16, 17	10.7	26.0
Monroe, La	122	40	15.2	30	2.4	3-6	5.2	12.8
Red River								
Denison, Tex.	768	22	5.2	3	1.3	29	2.4	3.9
Fulton, Ark.	515	28	15.5	24	7.3	1, 6	9.9	8.2
Shreveport, La.	327	29	8.2	26, 27	— 0.3	4-8	2.3	8.5
Alexandria, La.	118	33	12.8	30	2.3	11, 12	4.8	10.5
Mississippi River.								
Fort Ripley, Minn.	2,082	10	5.4	5	4.4	25, 26, 29, 30	4.8	1.0
St. Paul, Minn.	1,954	14	4.2	7	2.8	30	3.6	1.4
Red Wing, Minn.	1,914	14	2.7	9	1.7	29, 30	2.2	1.0
Reeds Landing, Minn	1,884	12	2.7	9	1.7	30	2.1	1.0
La Crosse, Wis.	1,819	12	3.6	11, 12	3.0	29, 30	3.3	0.6
Prairie du Chien, Wis.	1,759	18	3.8	9-11, 14-16	3.4	28-30	3.6	0.4
Dubuque, Iowa.	1,699	15	4.0	11	3.5	28-30	3.8	0.5
Leclaire, Iowa.	1,609	10	2.4	4-6	1.6	27-30	2.0	0.8
Davenport, Iowa	1,593	15	3.8	1	3.4	7, 8, 18-20, 29, 30	3.5	0.4
Muscatine, Iowa	1,562	16	4.4	1-4, 23, 24	4.0	10, 12, 20, 28	4.2	0.4
Galland, Iowa.	1,472	8	1.9	1, 26-30	1.5	10-17	1.7	0.4
Keokuk, Iowa.	1,463	15	3.2	3	2.7	16	2.9	0.5
Warsaw, Ill.	1,458	18	6.3	5	5.7	20-22	5.9	0.6
Hannibal, Mo	1,402	13	3.9	1	3.4	10-14, 20-26	3.5	0.5
Grafton, Ill	1,306	23	6.9	1	6.1	15-21, 25	6.3	0.8
St. Louis, Mo	1,264	30	7.2	1, 2	5.8	14-20, 23, 25-27	6.2	1.4
Chester, Ill	1,189	30	6.0	1-3	4.9	27	5.3	1.1
New Madrid, Mo.	1,003	34	15.2	21	8.1	2, 3	11.6	7.1
Luxora, Ark	905	33	8.0	22	2.6	6	5.1	5.4
Memphis, Tenn	843	33	12.9	23	6.6	4-7	9.3	6.3
Helena, Ark.	767	42	16.0	23, 24	8.9	7, 8	12.0	7.1
Arkansas City, Ark.	635	42	19.1	25, 26	9.6	7-9	13.4	9.5
Greenville, Miss.	595	42	15.1	26	7.5	7-9	10.3	7.6
Vicksburg, Miss.	474	45	15.4	28	6.6	9-12	9.7	8.8
Natchez, Miss.	373	46	17.1	30	8.6	11, 12	11.4	8.5
Baton Rouge, La.	240	35	11.2	30	4.6	14, 15	6.7	6.6
Donaldsonville, La	188	28	8.0	30	3.5	16	5.0	4.5
New Orleans, La.	108	16	5.7	30	3.3	16	4.5	2.4
Atchafalaya River.								
Simmesport, La.	127	33	15.0	30	3.5	13, 14	6.7	11.5
Melville, La.	103	31	18.8	30	7.6	14	10.9	11.2
Hudson River.								
Troy, N. Y	154	14	18.0	8	3.9	24, 29	7.2	14.1
Albany, N. Y.	147	12	13.9	8	1.7	29	5.2	12.2
Delaware River.								
Hancock (E. Branch), N. Y.	287	12	8.8	7	3.6	28-30	4.7	5.2
Hancock (W. Branch), N. Y.	287	10	7.8	8	3.4	29	4.6	4.4
Port Jervis, N. Y.	215	14	9.0	8	1.7	25, 29	3.1	7.3
Phillipsburg, N. J.	146	26	14.1	8	3.5	21	5.5	10.6
Trenton, N. J.	92	18	8.6	8	2.8	1, 2, 30	4.0	5.8
North Branch Susquehanna.								
Binghamton, N. Y.	183	16	10.1	8	3.0	24, 26-28	4.2	7.1
Wilkes-Barre, Pa.	60	17	14.4	9	5.1	26	7.5	9.3
West Branch Susquehanna.								
Williamsport, Pa.	39	20	5.3	5	1.8	27	3.0	3.5
Susquehanna River.								
Harrisburg, Pa.	69	17	6.8	10	2.7	22	4.0	4.1
Shenandoah River.								
Riverton, Va.	58	22	3.8	26	— 1.6	1-3	—0.6	5.4
Potomac River.								
Cumberland, Md.	290	8	4.4	29	2.5	1, 2	3.3	1.9
Harpers Ferry, W. Va.	172	18	7.0	26	— 0.4	1, 2	2.2	7.4
James River.								
Lynchburg, Va.	260	18	6.2	25	0.9	1, 2	2.5	5.3
Columbia, Va.	167	18	12.0	26	2.3	1, 2	5.6	9.7
Richmond, Va.	111	10	6.2	25	— 0.2	2	1.2	6.4
Roanoke River.								
Clarksville, Va	196	12	7.8	25	— 0.3	2	1.0	8.1
Weldon, N. C.	129	30	32.2	26	9.6	1	12.8	22.6
Tar River.								
Greenville, N. C.	21	22	11.2	29	3.2	1, 4, 5, 11	4.8	8.0
Cape Fear River.								
Fayetteville, N. C	112	38	26.3	25	1.1	1	6.3	25.2
Pedee River.								
Cheraw, S. C	149	27	24.7	25	1.8	1, 2	5.4	22.9
Smiths Mills, S. C.	51	16	11.1	30	1.3	1, 2	3.5	9.8
Lynch Creek.								
Effingham, S. C.	35	12	5.5	30	2.8	1, 2, 10, 11	3.7	2.7
Black River.								
Kingstree, S. C.	45	12	3.4	29, 30	0.4	8, 9	1.6	3.0

TABLE VI.—*Heights of rivers referred to zeros of gages*—Continued.

Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
Catawba-Wateree River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Mount Holly, N. C.	143	15	7.0	24	1.8	1-12	2.3	5.2
Catawba, S. C	107	11	9.6	24	1.6	17	3.0	8.0
Camden, S. C.	37	14	25.0	25	3.4	18	7.9	21.6
Congaree River.								
Columbia, S. C	52	15	11.5	25	0.0	3,10	2.4	11.5
Savannah River.								
Calhoun Falls, S. C.	347	15	7.0	22	2.7	8,9,16,17	3.5	4.3
Augusta, Ga.	268	32	22.5	28	5.2	10	9.1	17.3
Oconee River.								
Dublin, Ga	79	30	10.0	28	— 1.0	1,13	1.8	11.0
Ocmulgee River.								
Macon, Ga.	203	18	15.0	23	0.7	4,5	3.4	14.3
Flint River.								
Montezuma, Ga.	152	20	11.5	26	0.3	1	3.8	11.2
Albany, Ga.	90	20	8.7	28	0.5	1,2	2.7	8.2
Bainbridge, Ga.	29	22	10.1	30	2.9	11,12	4.4	7.2
Chattahoochee River.								
West Point, Ga	239	20	8.5	24	1.8	1,2,9	3.6	6.7
Eufaula, Ala	90	40	20.0	24	0.4	2	5.6	19.6
Alaga, Ala.	30	25	19.4	25	1.9	2	6.3	17.5
Coosa River.								
Rome, Ga.	266	30	13.5	25	0.7	1,2,9	3.2	12.8
Gadsden, Ala.	162	22	13.3	26	0.7	4	3.8	12.6
Lock No. 4, Ala.	113	17	10.3	25	0.6	4,5	3.2	9.7
Wetumpka, Ala	12	45	22.0	25	1.6	1	7.0	20.4
Alabama River.								
Montgomery, Ala.	323	35	20.2	25	0.1	6-8	4.9	20.1
Selma, Ala	246	35	24.6	26	0.0	1,2	5.8	24.6
Black Warrior River.								
Tuscaloosa, Ala.	90	43	17.0	25	5.2	1	7.6	11.8
Tombigbee River.								
Columbus, Miss	316	33	0.3	26	— 3.1	1	—2.1	3.4
Demopolis, Ala.	168	35	10.4	27	— 2.0	1,2,14	1.3	12.4
Pascagoula River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Merrill, Miss.	78	20	15.7	25	1.3	1	5.2	14.4
Pearl River.								
Columbia, Miss.	110	14	10.5	30	3.1	14-17	4.5	7.4
Sabine River.								
Logansport, La.	315	25	23.8	25,26	1.2	1	12.2	22.6
Neches River.								
Beaumont, Tex.	18	10	3.2	28	— 0.8	13	1.7	4.0
Trinity River.								
Dallas, Tex.	320	25	25.6	22	3.6	16	8.6	22.0
Long Lake, Tex.	211	35	37.8	27,28	4.6	16	19.9	33.2
Liberty, Tex	20	25	27.4	30	6.0	16	17.0	21.4
Brazos River.								
Waco, Tex.	285	22	9.1	20	4.1	4	5.4	5.0
Hempstead, Tex	140	40	39.0	24	4.0	16	16.7	35.0
Booth, Tex	61	39	35.3	24	3.4	1-4	15.7	31.9
Colorado River.								
Austin, Tex.	214	18	9.9	19	1.8	5	3.4	8.1
Columbus, Tex.	98	24	34.0	21	8.8	5,6	14.6	25.2
Red River of the North.								
Moorhead, Minn.	284	26	8.2	6,11,21	7.0	13,14	7.9	1.2
Snake River.								
Lewiston, Idaho	144	24	2.4	27	2.0	13-23	2.1	0.4
Columbia River.								
Wenatchee, Wash	473	40	7.5	1	5.9	28-30	6.5	1.6
Umatilla, Oreg	270	25	3.2	1,2	2.4	22-25	2.7	0.8
The Dalles, Oreg.	166	40	3.8	2-4	2.6	21-23	3.1	1.2
Willamette River.								
Albany, Oreg.	118	20	10.5	26	0.7	12,13	2.6	9.8
Portland, Oreg.	12	15	8.8	26	1.3	11	3.6	7.5
Sacramento River.								
Red Bluff, Cal.	265	23	1.7	1	0.9	13-17	1.1	0.8
Colusa, Cal	156	28	4.5	1	3.6	18-20	3.8	0.9
Knights Landing, Cal.	99	18	3.4	2	2.5	11,16-19	2.7	0.9
Sacramento, Cal.	64	25	8.4	2	7.5	18,21,22	7.8	0.9

Honolulu, T. H., latitude 21° 19′ north, longitude 157° 30′ west; barometer above sea, 38 feet; gravity correction, —0.057 inch, applied. November, 1907.

Day.	Pressure.* 8 a. m.	Pressure.* 8 p. m.	Air temperature. 8 a. m.	Air temperature. 8 p. m.	Air temperature. Maximum.	Air temperature. Minimum.	Moisture. 8 a. m. Wet.	Moisture. 8 a. m. Relative humidity.	Moisture. 8 p. m. Wet.	Moisture. 8 p. m. Relative humidity.	Wind. 8 a. m. Direction.	Wind. 8 a. m. Velocity.	Wind. 8 p. m. Direction.	Wind. 8 p. m. Velocity.	Precipitation. 8 a. m.	Precipitation. 8 p. m.	Clouds. 8 a. m. Amount.	Clouds. 8 a. m. Kind.	Clouds. 8 a. m. Direction.	Clouds. 8 p. m. Amount.	Clouds. 8 p. m. Kind.	Clouds. 8 p. m. Direction.
1	30.10	30.09	77.0	72.0	80	69	67.5	61	70.0	91	ne.	13	e.	10	0.17	0.05	4	Cu.	e.	10	N.	e.
2	30.13	30.06	76.5	76.0	79	69	67.4	62	66.0	59	e.	9	ne.	9	0.16	0.00	5	Cu.	ne.	Few	Cu.	ne.
3	30.06	30.00	75.5	72.0	79	71	67.0	64	67.0	77	ne.	9	ne.	9	T.	0.03	9	Cu.	e.	7	S.	ne.
4	29.97	29.95	75.0	73.5	80	71	67.0	66	67.5	74	ne.	13	w.	3	0.01	0.00	9	A.-s.	w.	Few	Cu.	ne.
5	29.95	29.93	73.5	71.0	78	69	66.5	69	65.0	72	n.	5	nw.	8	0.00	0.02	5 3	A.-s. S.	sw. 0	2	S.	ne.
6	29.98	29.95	73.0	69.0	79	65	60.5	48	61.5	65	n.	7	ne.	4	0.00	0.00	8 1	Ci.-s. A.-s.	sw. 0	0	0	0
7	29.95	29.90	70.4	71.0	76	65	63.0	67	66.0	77	n.	4	n.	12	0.00	0.00	9	S.-cu.	n.	10	S.	n.
8	29.93	29.92	75.0	72.5	80	66	66.5	64	66.0	71	n.	5	ne.	15	0.00	0.00	5	A.-cu.	0	Few	Cu.	ne.
9	29.96	29.97	75.5	72.5	82	69	66.0	60	67.0	75	w.	2	ne.	3	T.	0.00	Few	Cu.	0	4	A.-s.	sw.
10	30.02	30.02	72.0	73.2	79	69	70.0	91	69.2	82	se.	3	s.	2	0.35	0.06	10	S.	0	10	S.	ne.
11	30.04	30.03	79.0	75.0	83	72	69.0	64	70.0	78	se.	3	n.	2	0.00	0.00	4	A.-cu.	s.	Few	A.-s.	sw.
12	30.06	30.02	76.4	74.0	82	69	70.3	74	67.0	69	w.	2	se.	3	0.00	0.00	Few	Cu.	e.	Few	Cu.	ne.
13	30.08	30.04	75.0	76.0	82	70	70.2	79	67.0	62	w.	2	ne.	14	0.00	0.00	Few	Cu.	e.	2 1	A.-s. Cu.	w. ne.
14	30.10	30.09	77.0	74.0	79	73	68.0	63	70.0	82	e.	9	ne.	10	0.00	T.	7	Cu.	e.	6	Cu.	ne.
15	30.08	30.03	76.0	75.5	80	68	68.0	66	67.0	64	e.	13	ne.	14	0.02	0.00	4	Cu.	e.	4	Cu.	ne.
16	30.07	30.05	76.0	76.0	82	72	68.0	66	67.5	64	e.	4	se.	16	0.00	T.	6	Cu.	e.	3	Cu.	ne.
17	30.09	30.02	74.4	74.0	80	71	68.1	72	69.0	78	e.	8	ne.	8	T.	T.	9	Cu.	e.	9	N.	ne.
18	30.06	30.05	74.7	76.0	79	72	67.4	68	68.0	66	e.	14	ne.	12	T.	T.	7	Cu.	e.	6	Cu.	ne.
19	30.05	30.06	75.5	75.0	79	72	68.0	68	68.0	70	e.	16	e.	20	0.00	T.	7	S.-cu.	e.	6 1	A.-s. Cu.	w. ne.
20	30.09	30.07	74.0	75.0	77	71	67.3	70	68.0	70	ne.	11	ne.	12	T.	0.05	8	Cu.	e.	6	Cu.	ne.
21	30.10	30.05	74.2	74.0	80	69	69.0	77	69.0	78	ne.	5	e.	13	0.02	0.20	4	Cu.	e.	5	N.	ne.
22	30.06	30.04	76.0	75.0	79	69	68.5	68	68.0	70	e.	13	e.	19	0.05	0.02	3 4	A.-cu. Cu.	0 e.	2	Cu.-n.	e.
23	30.05	30.03	76.6	75.0	81	73	68.5	66	69.0	74	e.	8	e.	8	0.00	0.00	2	Cu.	e.	Few	Cu.	e.
24	30.09	30.09	76.0	75.5	80	72	68.5	68	67.5	66	ne.	4	ne.	11	0.02	0.00	8	Cu.	e.	5	S.	ne.
25	30.10	30.08	74.0	72.5	78	70	67.2	70	68.0	80	ne.	10	ne.	12	0.01	0.09	5 3	Cu. N.	e. e.	9	N.	ne.
26	30.10	30.07	74.0	72.5	77	67	66.0	65	66.0	71	ne.	18	ne.	20	0.62	0.02	4	Cu.	e.	2	Cu.	ne.
27	30.05	30.06	72.0	73.0	76	70	66.0	73	67.0	73	ne.	14	ne.	17	T.	0.09	7	Cu.	e.	2 2	Cu.-n. S.	ne. e.
28	30.06	30.04	74.0	70.0	78	70	66.2	66	66.0	81	ne.	7	ne.	9	0.00	T.	1	Cu.	e.	9	S.	ne.
29	30.08	30.07	73.5	71.4	78	68	64.0	60	66.0	75	ne.	5	ne.	4	T.	0.00	Few	Cu.	ne.	5	S.	ne.
30	30.04	30.03	74.0	70.0	78	64	66.2	66	65.0	77	ne.	3	ne.	12	0.00	0.00	3	Cu.	e.	0	0	0
31																						
Mean	30.050	30.027	74.9	73.4	79.3	69.5	67.2	67.4	67.3	73.0	ne.	8.0	ne.	10.4	1.43	0.63	5.7	Cu.	e.	4.3	Cu.	ne.

Observations are made at 8 a.m. and 8 p. m., local standard time, which is that of 157° 30′ west, and is 5h and 30m slower than 75th meridian time. *Pressure values are reduced to sea level and standard gravity.

Chart I. Hydrographs for Seven Principal Rivers of the United States, November, 1907.

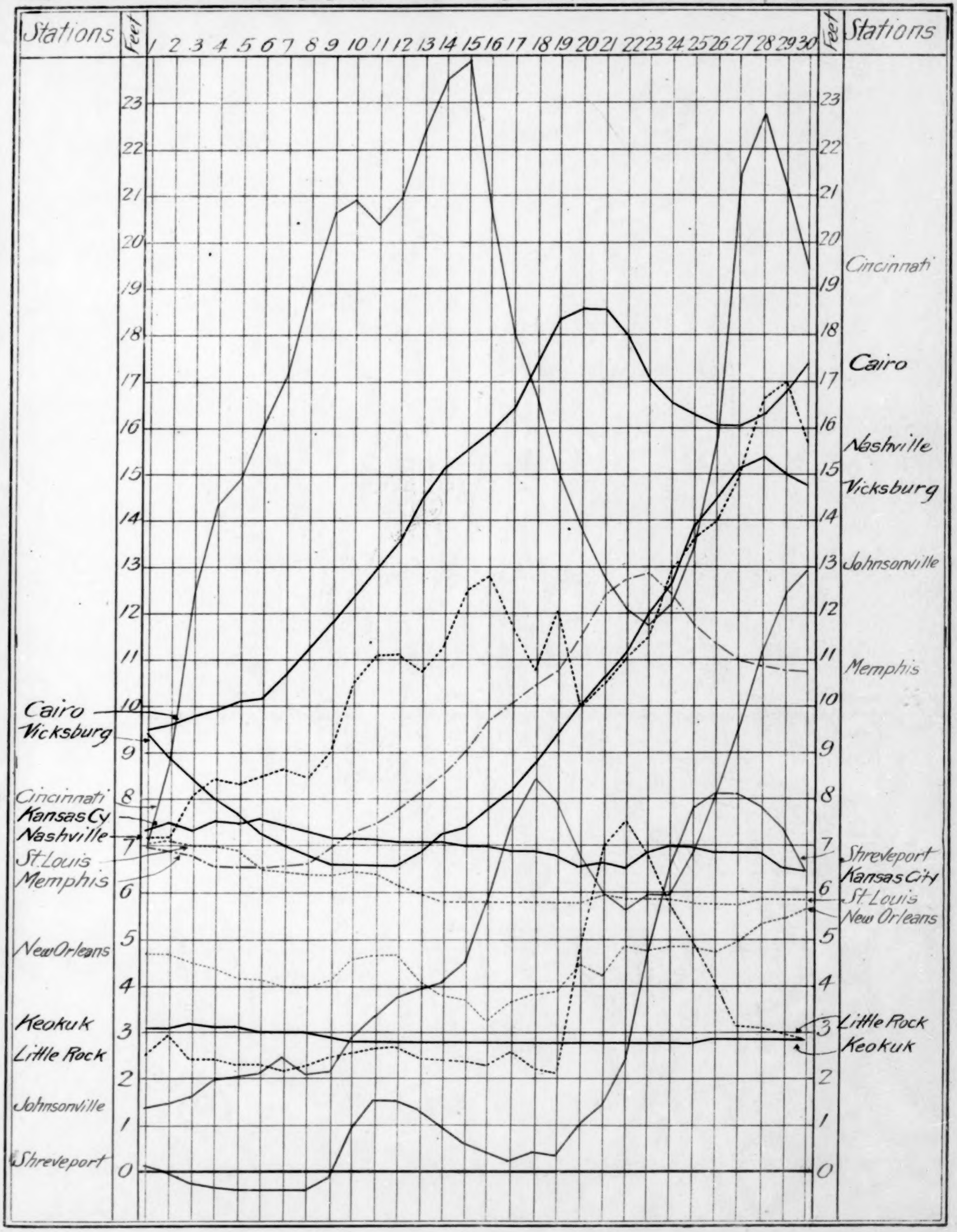


Chart II. Tracks of Centers of High Areas, November, 1907.

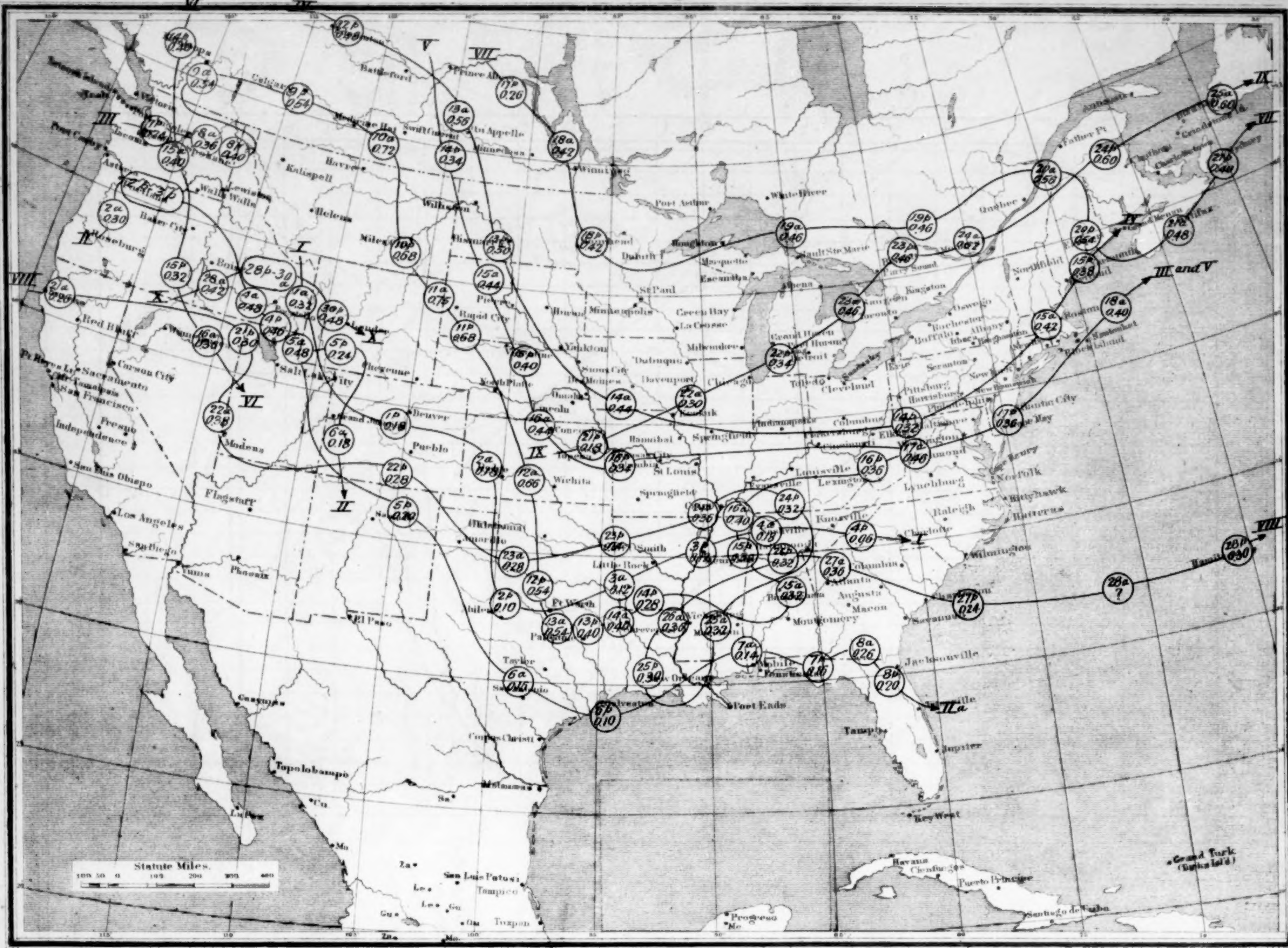


Chart III. Tracks of Centers of Low Areas, November, 1907.

Chart III. Tracks of Centers of Low Areas, November, 1907.

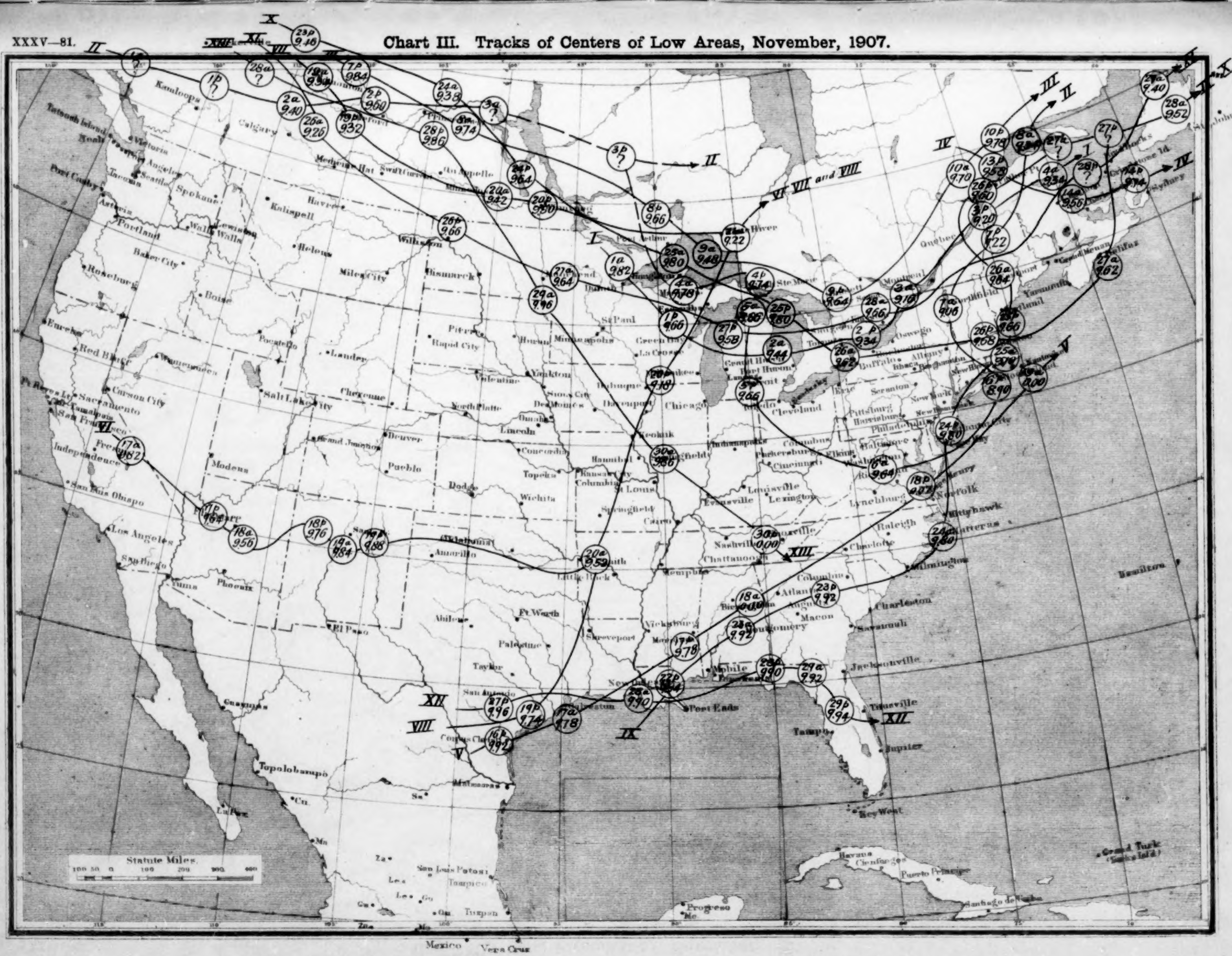
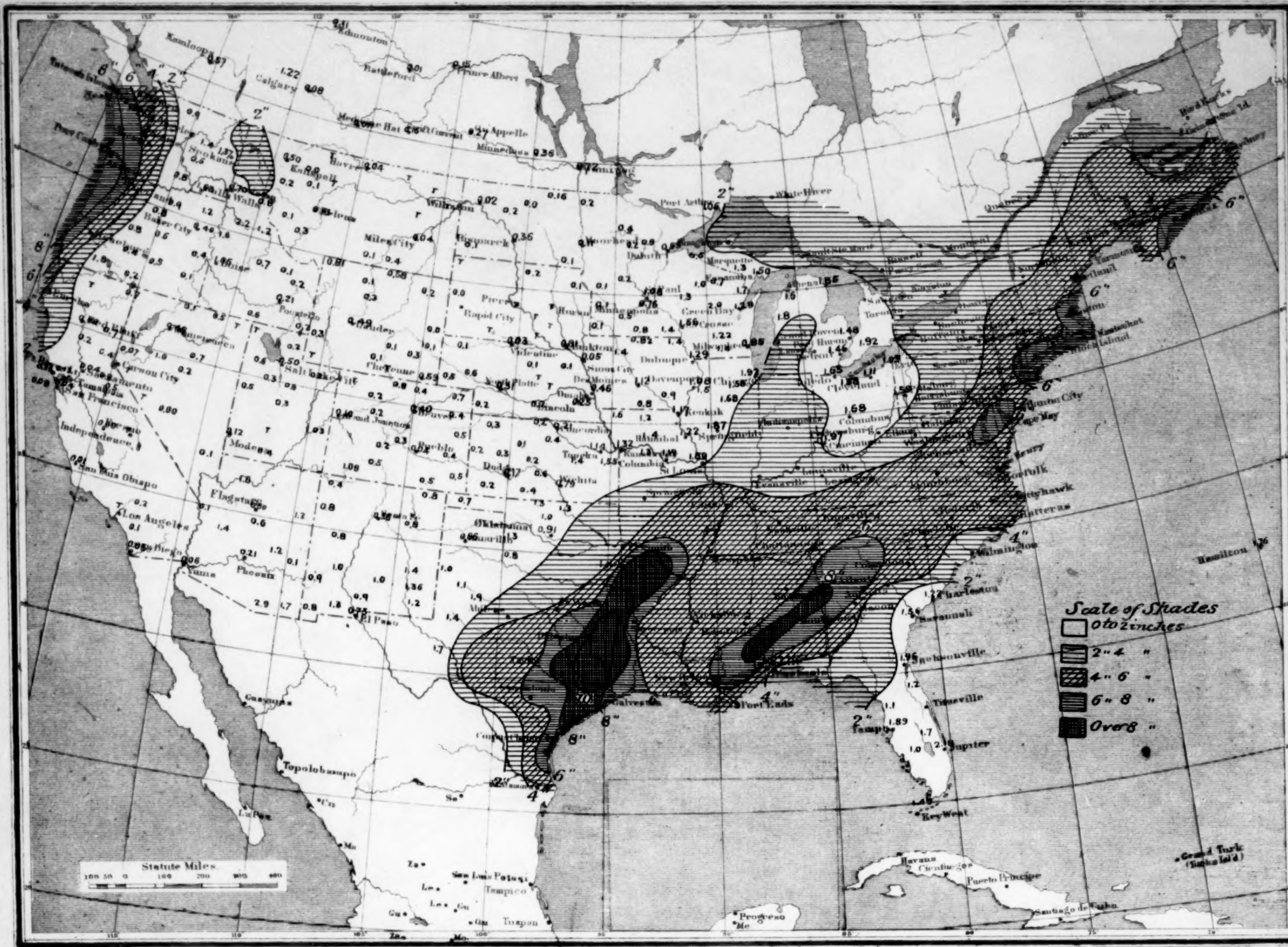
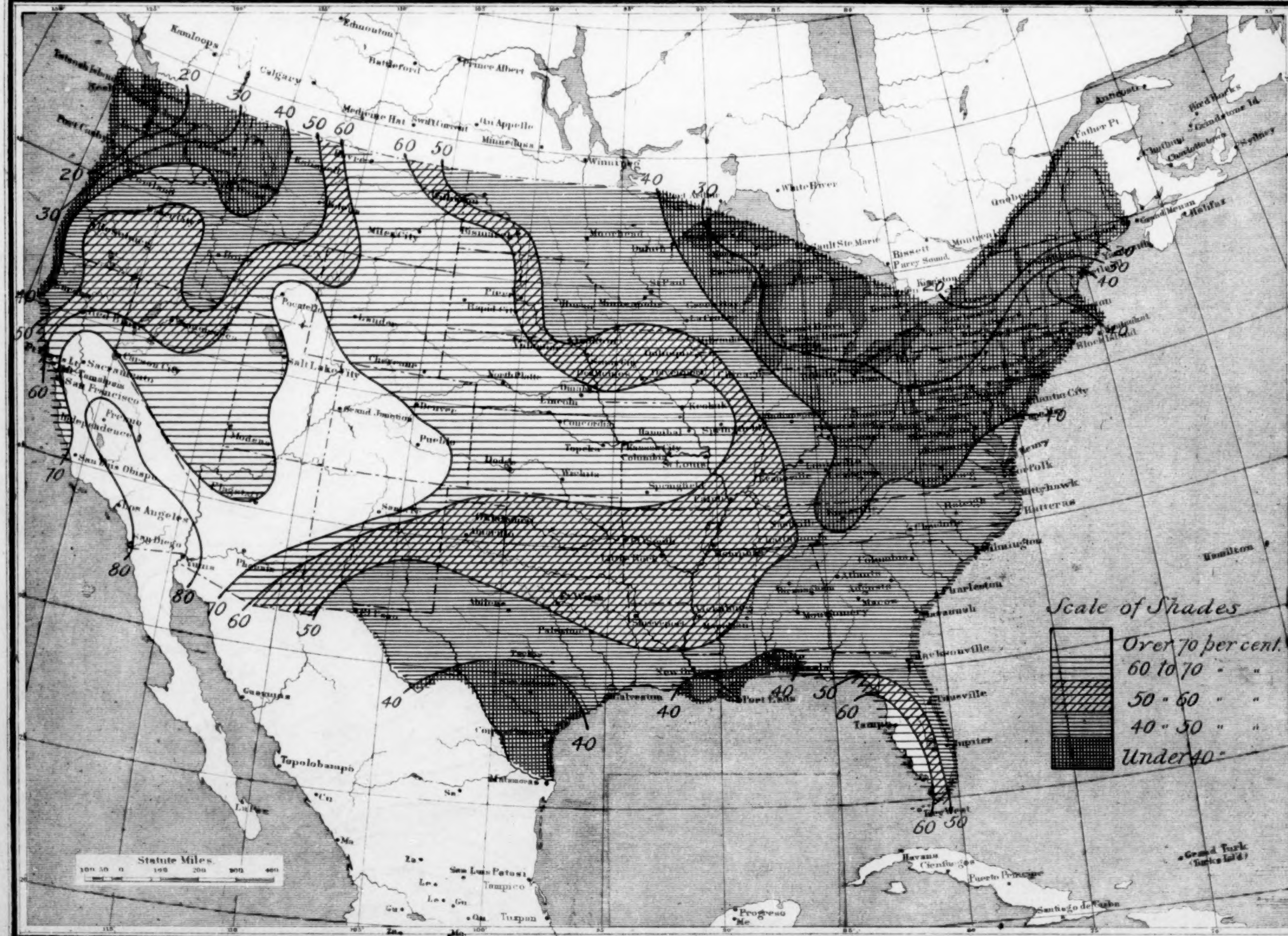


Chart IV. Total Precipitation, November, 1907.

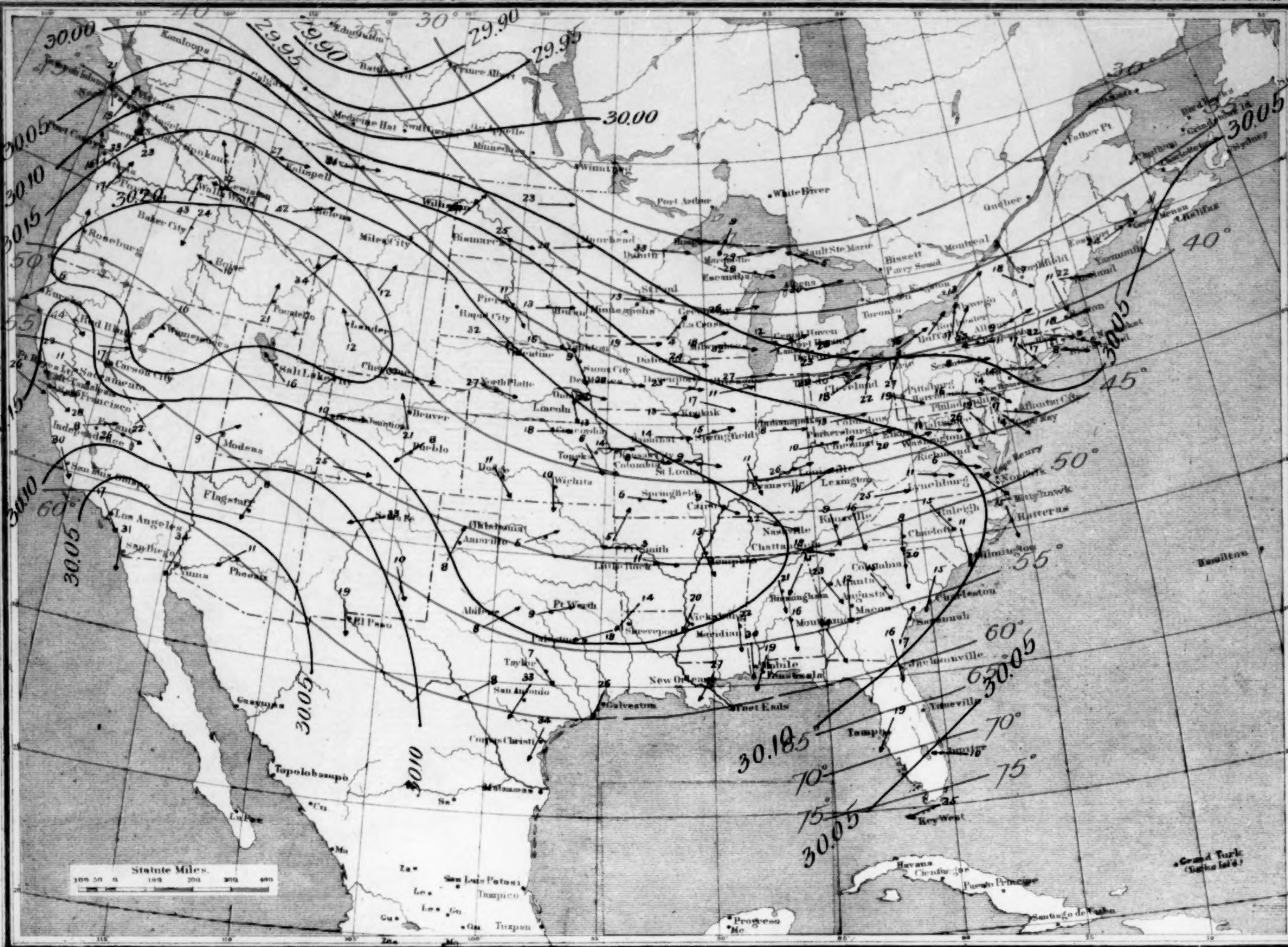


• Barkerville **Chart V. Percentage of Clear Sky between Sunrise and Sunset, November, 1907.**

Chart V. Percentage of Clear Sky between Sunrise and Sunset, November, 1907.



• Baskerville Chart VI. Isobars and Isotherms at Sea Level; Surface Wind Resultants, November, 1907.



• Baskerville

Chart VII. Total Snowfall for November, 1907.

Chart VII. Total Snowfall for November, 1907.

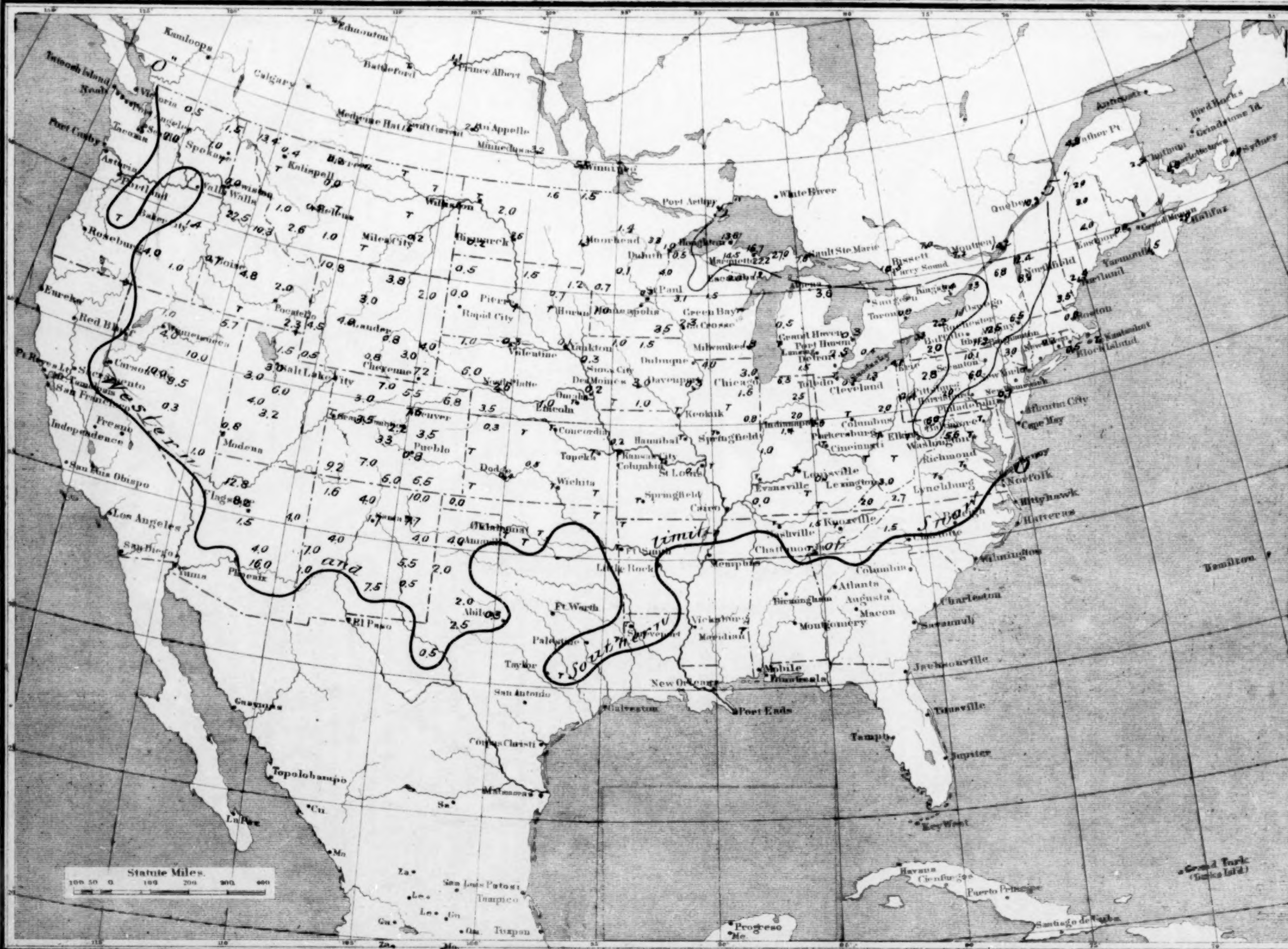


Chart VIII. Depth of Snow on Ground, November 30, 1907.